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Architecture Amidst Smog

Hui Sheng

ARCHITECTURE AMIDST SMOG

HUI SHENG
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Advisor: David Shanks
Syracuse University

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1. SMOG AS A PROBLEM

SMOG IN A YEAR
SMOG IN HISTORY
CAUSES AND EFFECTS OF SMOG
EXTENSIONS FROM THE SMOG PROBLEM

Fig. 01 A Series of Smog. Photographs Taken in Beijing, 2013

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SMOG AS A PROBLEM

Fig. 01 A Series of Photographs Taken in Beijing, 2013

SMOG IN A YEAR

This series of images show a location in Beijing during clear and hazy days. During hazy days, the visibility decreased greatly and the air quality was poor because of extremely high levels of smog.

SMOG: A type of air pollutant. Fog or haze combined with smoke and other atmospheric pollutants.

It changes with the change of seasons. Usually it becomes heavier around winter in China, due to winter heating requirement and static stability weathers happening in winter.

Fig. 02 Trafalgar Square, London, 1952

Fig. 03 Trafalgar Square, London, 2001

Fig. 04 Los Angeles, 1968

Fig. 05 Los Angeles, 2005

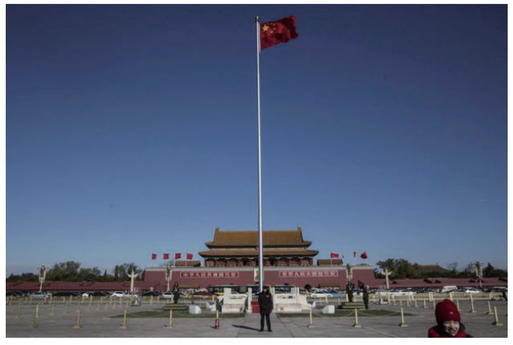


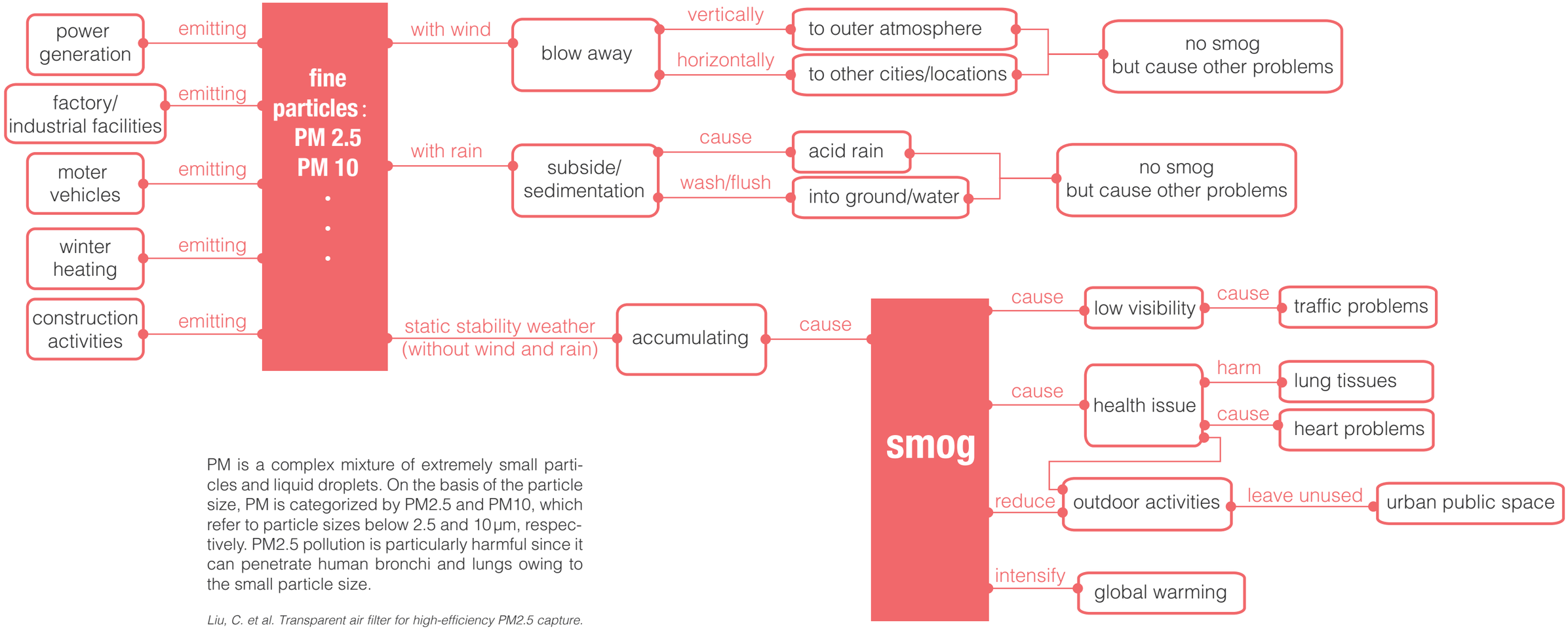
Fig. 06 Tian'anmen Square, Beijing, 2015

Fig. 07 Tian'anmen Square, Beijing, 2015

The Great Smog of 1952, was a severe air-pollution event that affected the British capital of London in December 1952. A period of cold weather, combined with an anticyclone and windless conditions, collected airborne pollutants to form a thick layer of smog over the city. 4,000 people had died as a direct result of the smog and 100,000 more were made ill by the smog's effects on the human respiratory tract.

Back in the 1950s and '60s, people in Los Angeles breathed some of the dirtiest air in the world.
Photochemical smog was first identified in Los Angeles in 1944. Although several other kinds of smog occur, photochemical smog (or Los Angeles-type smog) is a yellow-brown haze produced by the reaction of sunlight with exhaust from automobiles and power plants that burn coal.

Air exists in everywhere. We may take it for granted for most of the time. But what happened in Northern China in recent years, similar to London and LA, is that the air has been polluted so badly that we cannot ignore it, or the alteration of it. It becomes a slowly growing disaster for the entire country.



PM is a complex mixture of extremely small particles and liquid droplets. On the basis of the particle size, PM is categorized by PM2.5 and PM10, which refer to particle sizes below 2.5 and 10 µm, respectively. PM2.5 pollution is particularly harmful since it can penetrate human bronchi and lungs owing to the small particle size.

Liu, C. et al. Transparent air filter for high-efficiency PM2.5 capture. Nat. Commun. 6:6205 doi: 10.1038/ncomms7205 (2015).

Fig. 08 Inflatable dome with air purification system(electric generators)

Outdoor fine particles: 0.143 milligram/m2
Indoor fine particles: 0.002 milligram/m2

Indoor PM2.5 less than 20 no matter how bad outdoor air is.

cost 5,000,000 dollars to build
area: 8000m2

Fig. 09 Interior view of inflatable dome

International School of Beijing, Shun yi, Beijing

Students MUST be foreign employees'children in Beijing (whose parents work for the Chinese government).
American: 44%
Korean: 15%
Canadian: 11%
tuition: 30,000 dollars/year

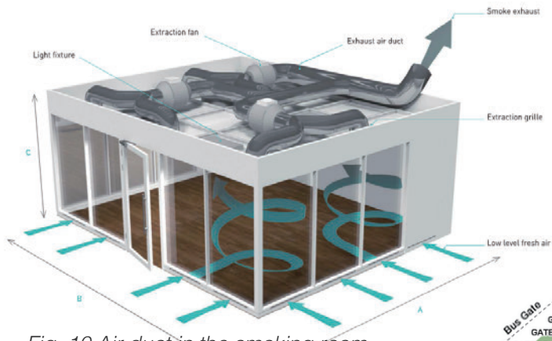


Fig. 10 Air duct in the smoking room

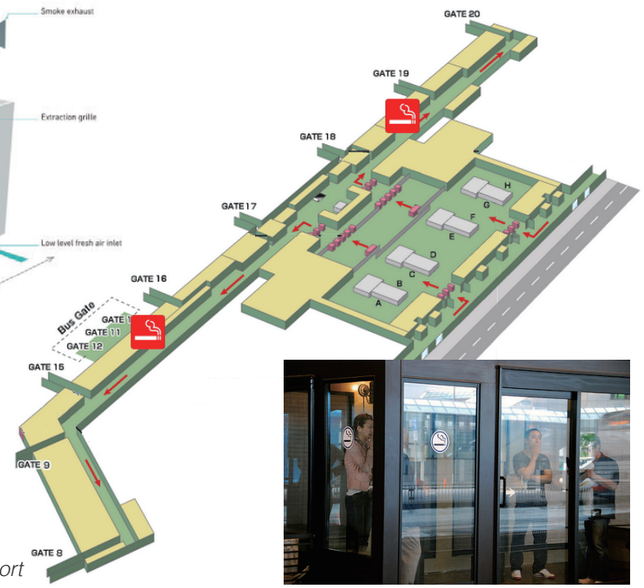


Fig. 11 Circulation in airport

Fig. 12 Smoking room in airport

"Smoke is a signifier of class, and the ability to command one's smoky exhalations is a signifier of class position. What type of smoke one engages with and the kinds of smoke that cling to us are indicative of social rank and the level of command one has over his or her environment." (Gissen, 49)

"Smoke is less explored with architectural thought. Architectural critic Herbert Muschamp argued that, in the city, smoke functions as a type of veil(面纱) for obscuring the city's rough edges, adding glamour to its interiors and surroundings." (Gissen, 52)

"Smoking rooms in large urban airports, where smokers are collected into glass rooms and their enjoyment of tobacco becomes a suspect form of pleasure, a strange pause in spaces that emphasize movement." (Gissen, 52)

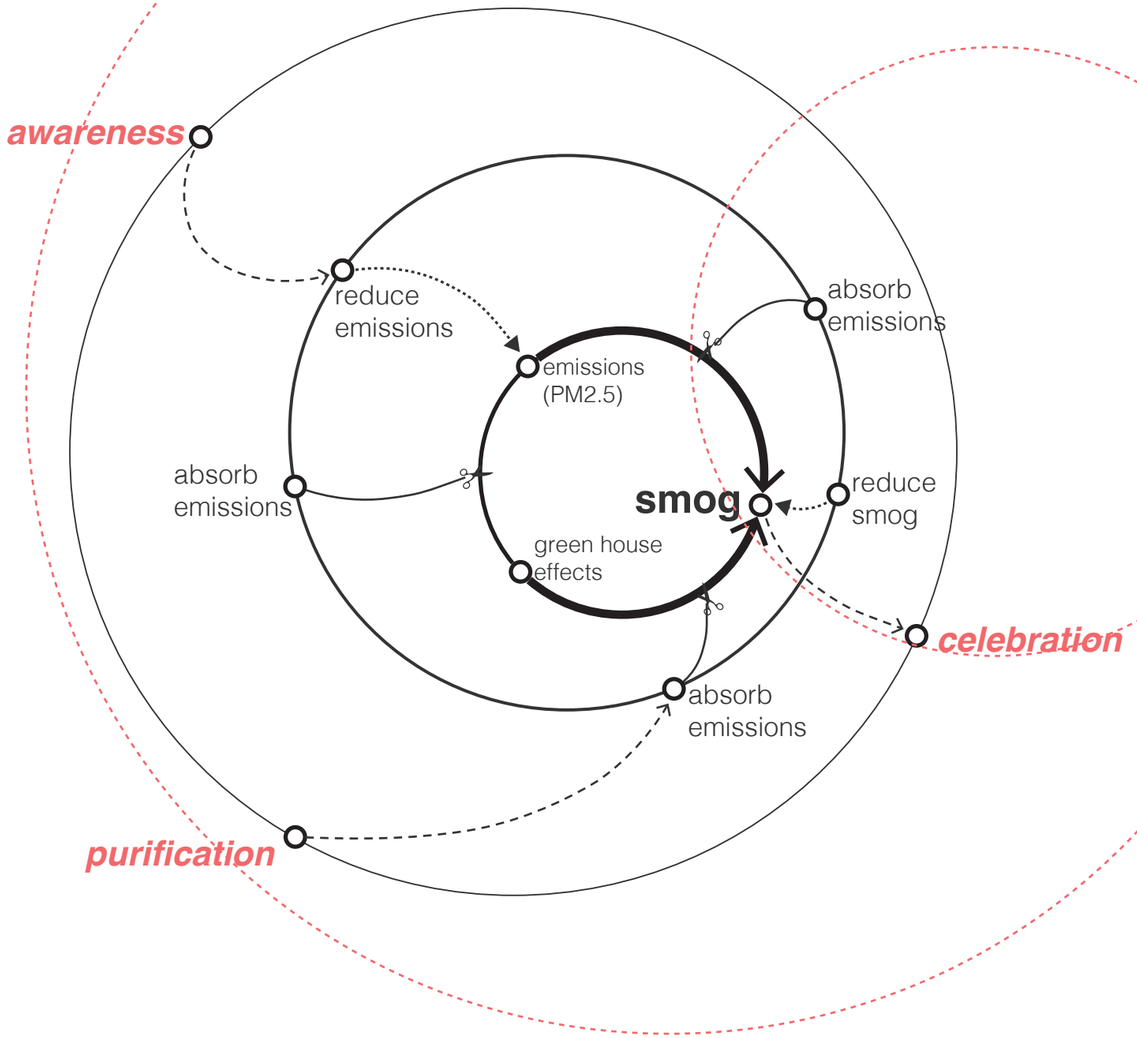
2. SMOG AS A POSSIBILITY

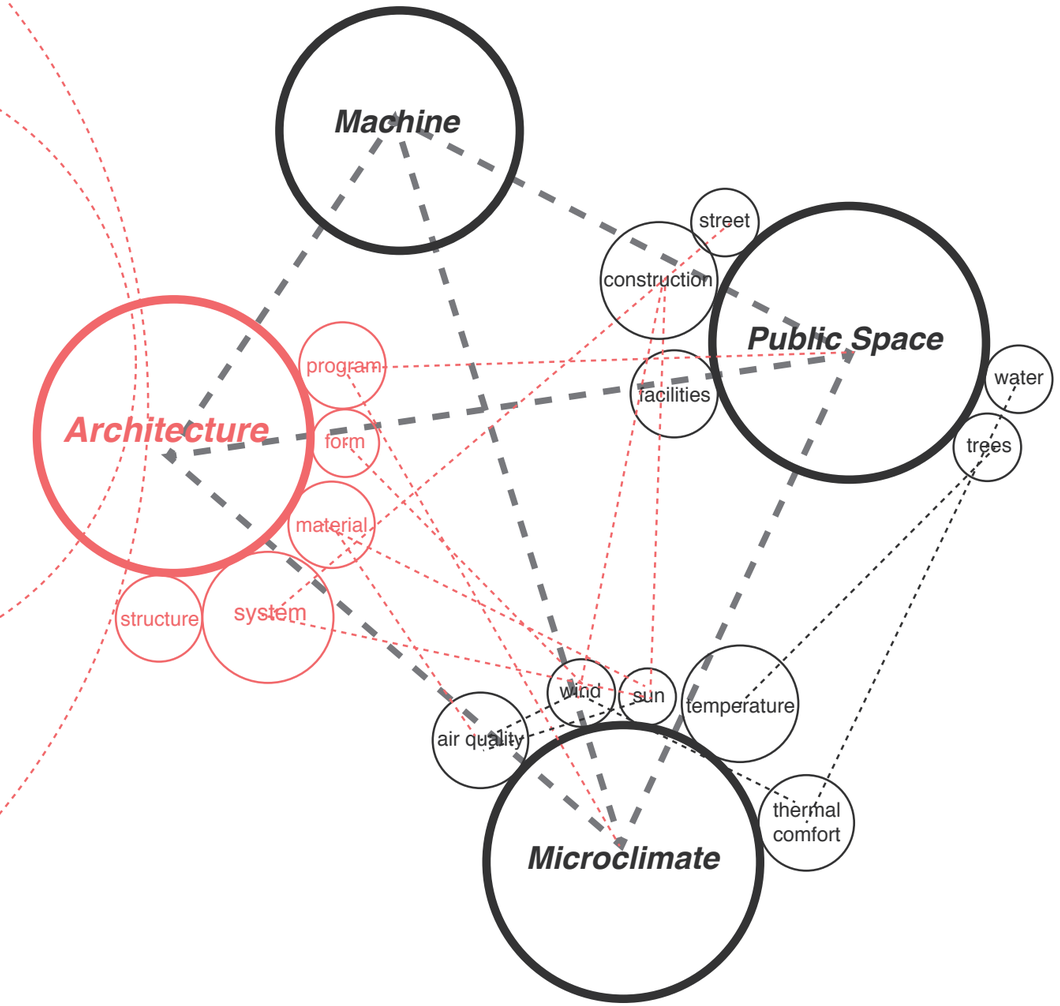
SPECTRUM OF SOLUTIONS
ROLES OF ARCHITECTURE
METHOD 1: VISUALIZATION
METHOD 2: SPATIALIZATION
CLAIM

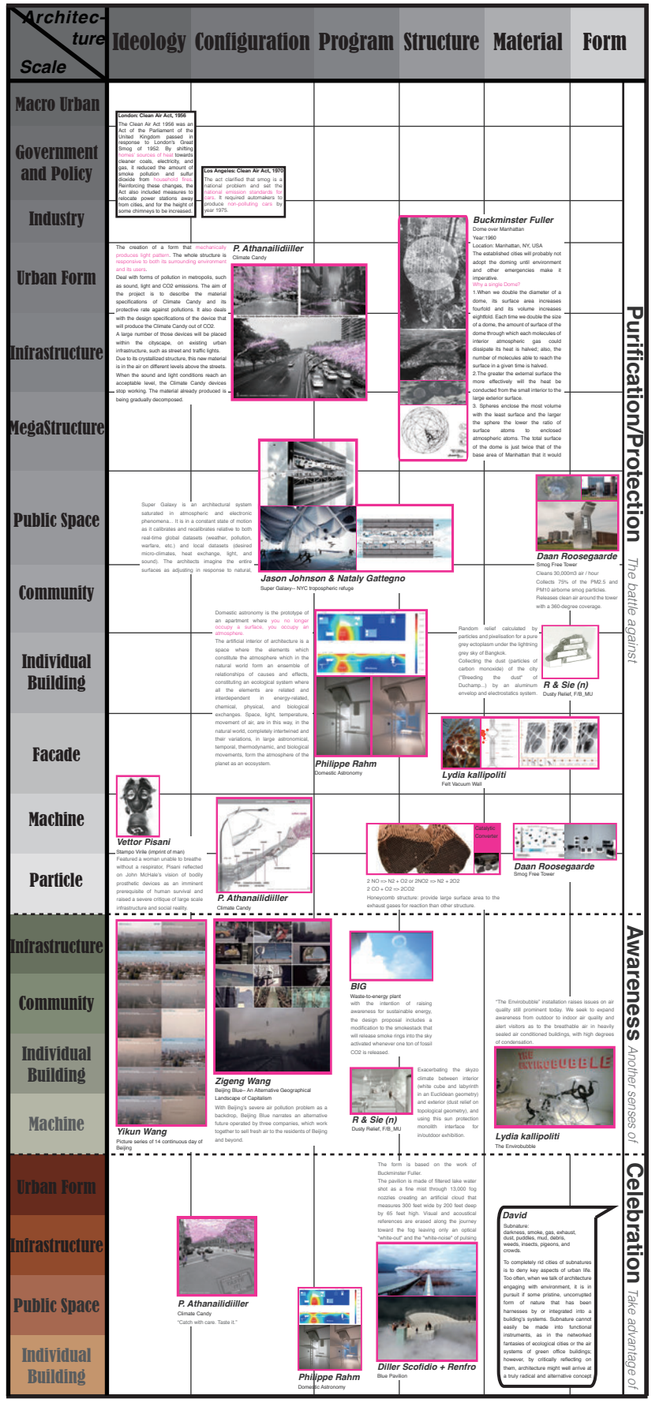
SMOG AS A POSSIBILITY

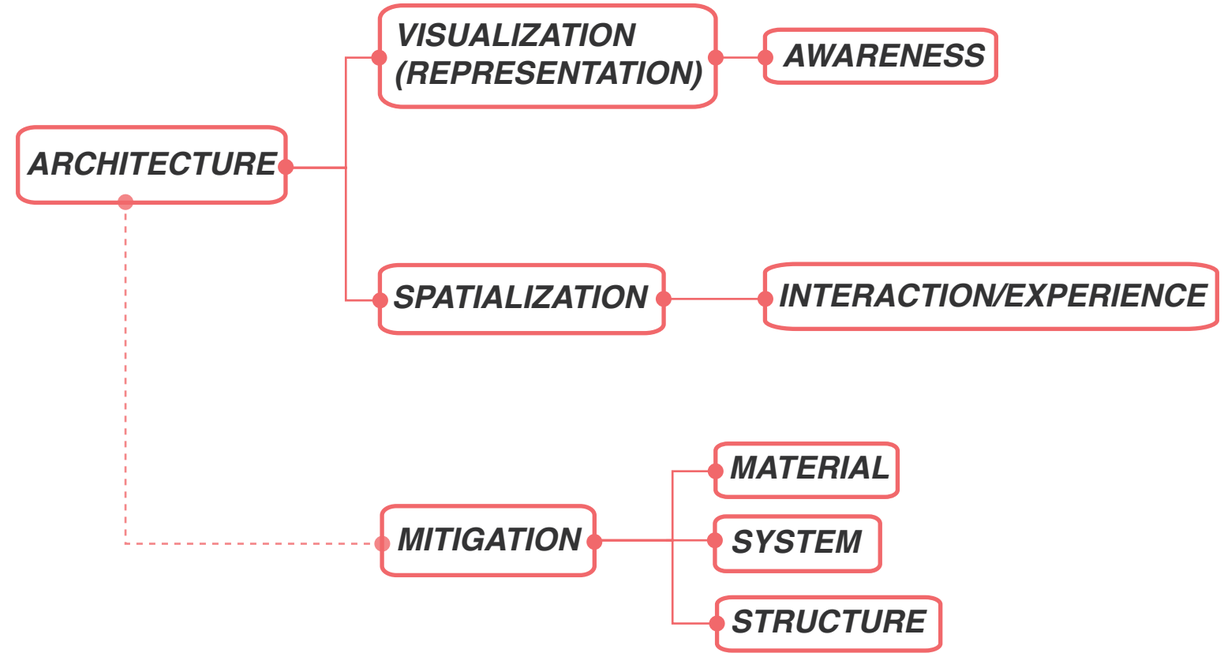
SPECTRUM OF SOLUTIONS

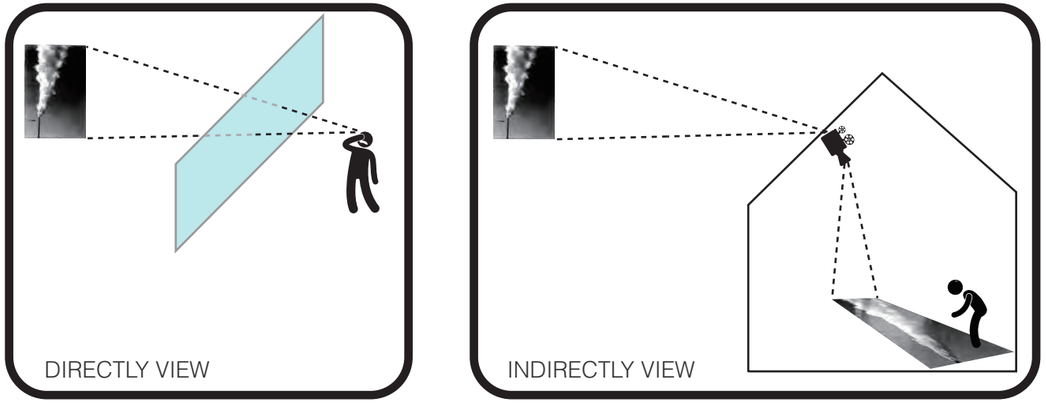
Macro Urban | Government and Policy | Industry | Urban Form | Infrastructure | Public Space | Architecture | Facade | Machine | Chemistry | Nano






Architec-ture
Scale
Ideology
Configuration
Program
Structure
Material
Form
Macro Urban
Government and Policy
Industry
Urban Form
Infrastructure
MegaStructure
Public Space
Community
Individual Building
Facade
Machine
Particle
Infrastructure
Community
Individual Building
Machine
Urban Form
Infrastructure
Public Space
Individual Building
Purification/Protection The battle against
Awareness Another senses of
Celebration Take advantage of
London Clean Air Act, 1956
The Clean Air Act 1956 was an Act of the Parliament of the United Kingdom passed in response to London's Great Smog of 1952. By shifting domes sources of heat towards cleaner coals, electricity, and gas, it aimed to reduce deaths from smoke pollution and sulfur dioxide from household fires. Reinforcing these changes, the Act also included measures to relocate power stations away from cities, and for the height of some chimneys to be increased.
Los Angeles: Clean Air Act, 1970
The act clarified that smog is a national problem and set the national emission standards for cars. It required automakers to produce non-polluting cars by year 1975.
P. Athanailidiiller
Climate Candy
The creation of a form that mechanically produces light pattern. The whole structure is responsive to both its surrounding environment and its users.
Deal with forms of pollution in metropolis, such as sound, light and CO2 emissions. The aim of the project is to describe the material specifications of Climate Candy and its protective rate against pollutions. It also deals with the design specifications of the device that will produce the Climate Candy out of CO2.
A large number of those devices will be placed within the cityscape, on existing urban infrastructure, such as street and traffic lights.
Due to its crystallized structure, this new material is in the air on different levels above the streets.
When the sound and light conditions reach an acceptable level, the Climate Candy devices stop working. The material already produced is being gradually decomposed.
Buckminster Fuller
Dome over Manhattan
Year:1960
Location: Manhattan, NY, USA
The established cities will probably not adopt the doming until environment and other emergencies make it imperative.
Why a single Dome?
1.When we double the diameter of a dome, its surface area increases fourfold and its volume increases eightfold. Each time we double the size of a dome, the amount of surface of the dome through which each molecules of interior atmospheric gas could dissipate its heat is halved; also, the number of molecules able to reach the surface in a given time is halved.
2.The greater the external surface the more effectively will the heat be conducted from the small interior to the large exterior surface.
3. Spheres enclose the most volume with the least surface and the larger the sphere the lower the ratio of surface atoms to enclosed atmospheric atoms.The total surface of the dome is just twice that of the base area of Manhattan that it would
Super Galaxy is an architectural system saturated in atmospheric and electronic phenomena... It is in a constant state of motion as it calibrates and recalibrates relative to both real-time global datasets (weather, pollution, warfare, etc.) and local datasets (desired micro-climates, heat exchange, light, and sound). The architects imagine the entire surfaces as adjusting in response to natural,
Jason Johnson & Nataly Gattegno
Super Galaxy– NYC tropospheric refuge
Daan Roosegaarde
Smog Free Tower
Cleans 30,000m3 air / hour
Collects 75% of the PM2.5 and PM10 airborne smog particles.
Releases clean air around the tower with a 360-degree coverage.
Domestic astronomy is the prototype of an apartment where you no longer occupy a surface, you occupy an atmosphere.
The artificial interior of architecture is a space where the elements which constitute the atmosphere which in the natural world form an ensemble of relationships of causes and effects, constituting an ecological system where all the elements are related and interdependent in energy-related, chemical, physical, and biological exchanges. Space, light, temperature, movement of air, are in this way, in the natural world, completely intertwined and their variations, in large astronomical, temporal, thermodynamic, and biological movements, form the atmosphere of the planet as an ecosystem.
Philippe Rahm
Domestic Astronomy
Random relief calculated by particles and pixelisation for a pure grey ecosystem under the lightning grey sky of Bangkok.
Collecting the dust (particles of carbon monoxide) of the city ("Breeding the dust" of Duchamp...) by an aluminum envelop and electrostatics system.
R & Sie (n)
Dusty Relief, F/B_MU
Lydia kallipoliti
Fett Vacuum Wall
Vettor Pisani
Stampo Virile (imprint of man)
Featured a woman unable to breathe without a respirator, Pisani reflected on John McHale's vision of bodily prosthetic devices as an imminent prerequisite of human survival and raised a severe critique of large scale infrastructure and social roles.
P. Athanailidiiller
Climate Candy
2 NO => N2 + O2 or 2NO2 => N2 + 2O2
2 CO + O2 => 2CO2
Honeycomb structure: provide large surface area to the exhaust gases for reaction than other structures.
Daan Roosegaarde
Smog Free Tower
Yikun Wang
Picture series of 14 continuous day of Beijing
Zigeng Wang
Beijing Blue– An Alternative Geographical Landscape of Capitalism
With Beijing's severe air pollution problem as a backdrop, Beijing Blue narrates an alternative future operated by three companies, which work together to sell fresh air to the residents of Beijing and beyond.
BIG
Waste-to-energy plant
with the intention of raising awareness for sustainable energy, the design proposal includes a modification to the smokestack that will release smoke rings into the sky activated whenever one ton of fossil CO2 is released.
R & Sie (n)
Dusty Relief, F/B_MU
Exacerbating the skyzo climate between interior twhite cube and labyrinth in an Euclidean geometry and exterior dust relief on topological geometry), and using this sun protection moonlith interface for in/outdoor exhibition.
"The Envirobubble" installation raises issues on air quality still prominent today. We seek to expand awareness from outdoor to indoor air quality and alert visitors as to the breathable air in heavily sealed air conditioned buildings, with high degrees of condensation.
Lydia kallipoliti
The Envirobubble
The form is based on the work of Buckminster Fuller.
The pavilion is made of filtered lake water shot as a fine mist through 13,000 fog nozzles creating an artificial cloud that measures 300 feet wide by 200 feet deep by 85 feet high. Visual and acoustical references are erased along the journey toward the fog leaving only an optical "white-out" and the "white-noise" of pulsing
David
Subnature:
darkness, smoke, gas, exhaust, dust, puddles, mud, debris, weeds, insects, pigeons, and crowds.
To completely rid cities of subnatures is to deny key aspects of urban life. Too often, when we talk of architecture engaging with environment, it is in pursuit if some pristine, uncorrupted form of nature that has been harnesses by or integrated into a building's systems. Subnature cannot easily be made into functional instruments, as in the networked fantasies of ecological cities or the air systems of green office buildings; however, by critically reflecting on them, architecture might well arrive at a truly radical and alternative concept
P. Athanailidiiller
Climate Candy
"Catch with care. Taste it."
Philippe Rahm
Domestic Astronomy
Diller Scofidio + Renfro
Blue Pavilion


ARCHITECTURE
VISUALIZATION (REPRESENTATION)
AWARENESS
SPATIALIZATION
INTERACTION/EXPERIENCE
MITIGATION
MATERIAL
SYSTEM
STRUCTURE



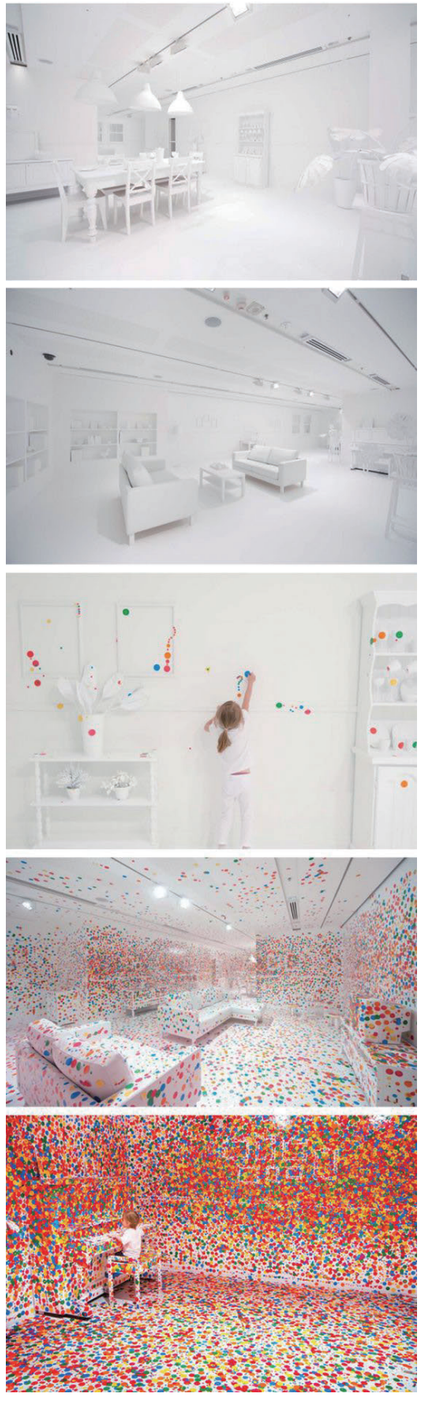
Data rearrangement, convertion and creation through visualization.

Through visualization, a changeable process is being represented. Visualization should show the object's fluidity and time-varying quality.

VISUALIZATION

Visualization is not only the tool that architects communicates with the publics to explain the project, but also a way to raise people's awareness by bringing the concept back to everyday life.

Visualization can imply photo-realistic animations, life recordings, drone flights, diagrammatic animations, hand drawings or video interviews with other people.



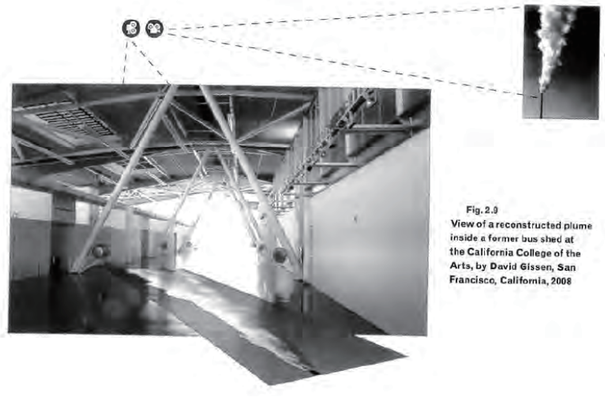
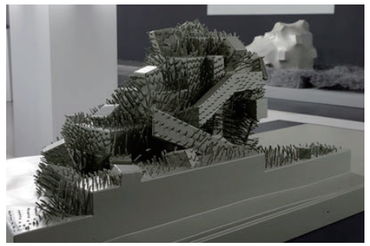


Fig. 2.0
View of a reconstructed plume inside a former bus shed at the California College of the Arts, by David Gissen, San Francisco, California, 2008

Historical reconstruction of the noxious plumes inside a former San Francisco bus shed, but now used as classrooms and studios for the California College of the Arts. The project, Plumeldling, reconstructs the space's former exhaust clouds by projecting a videotape of smoke emanating from one of the few remaining industrial facilities in the neighborhood.

By linking the old bus shed with current industrial plant, the project comments on how gentrification processes and the elimination of subnature work hand in hand.



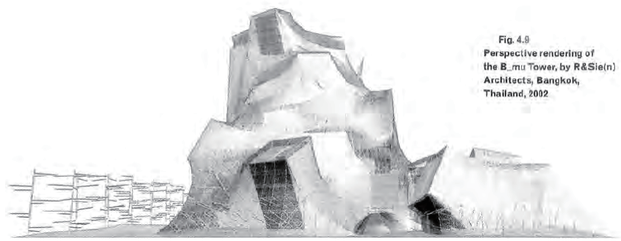
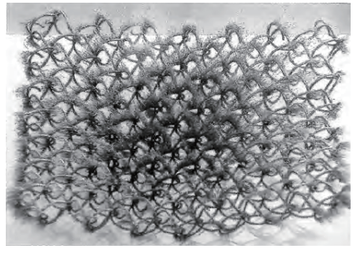


Fig. 4.9
Perspective rendering of the B_mu Tower, by R&Sie(n) Architects, Bangkok, Thailand, 2002



Explores exhaust as an environmental, urban, and social form.

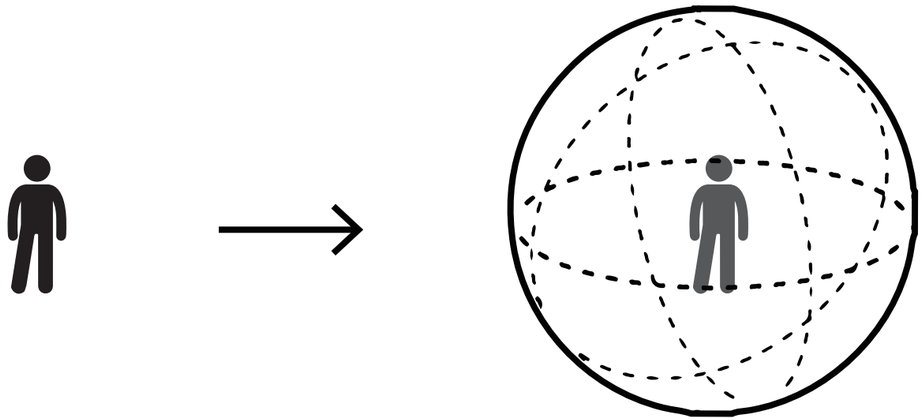
Enable us to understand our historically conditioned attitudes towards urban pollution and the ironic posture we often take when attempting to remediate it.

Rather than simply create a climate-controlled and environmentally filtered space for the people of the city, the firm used the building to “breed” the exhaust of the city onto the structure’s exterior surfaces.

Electrostatic skin that attracts the dusty exhaust also filters air. R&Sie(n) designed a building that simultaneously pulls exhaust towards it while developing a protected context from it. It enables us to VIEW THE POLLUTION OF THE CITY WITHIN A PROGRAMMATIC CONTEXT AND FORMAL TYPE.

It also enables us to see the ironies and potential loss of historical understanding inherent in seeking to achieve an ever-more depolluted and rarified environment.

In bringing us closer to exhaust, R&Sie(n) enables us to see its expulsive vapors, striking textures, climate effects, and qualities.

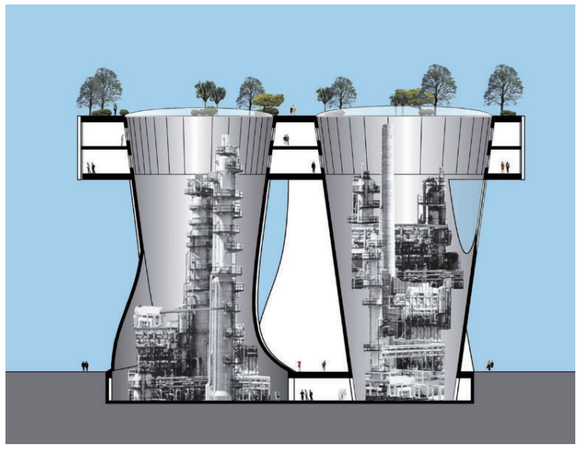


SPATIALIZATION

Spatialization allows for the depiction of information as an intricate design element. It activates space by giving and creating the meaning of scale, structure, and system in three dimensions.

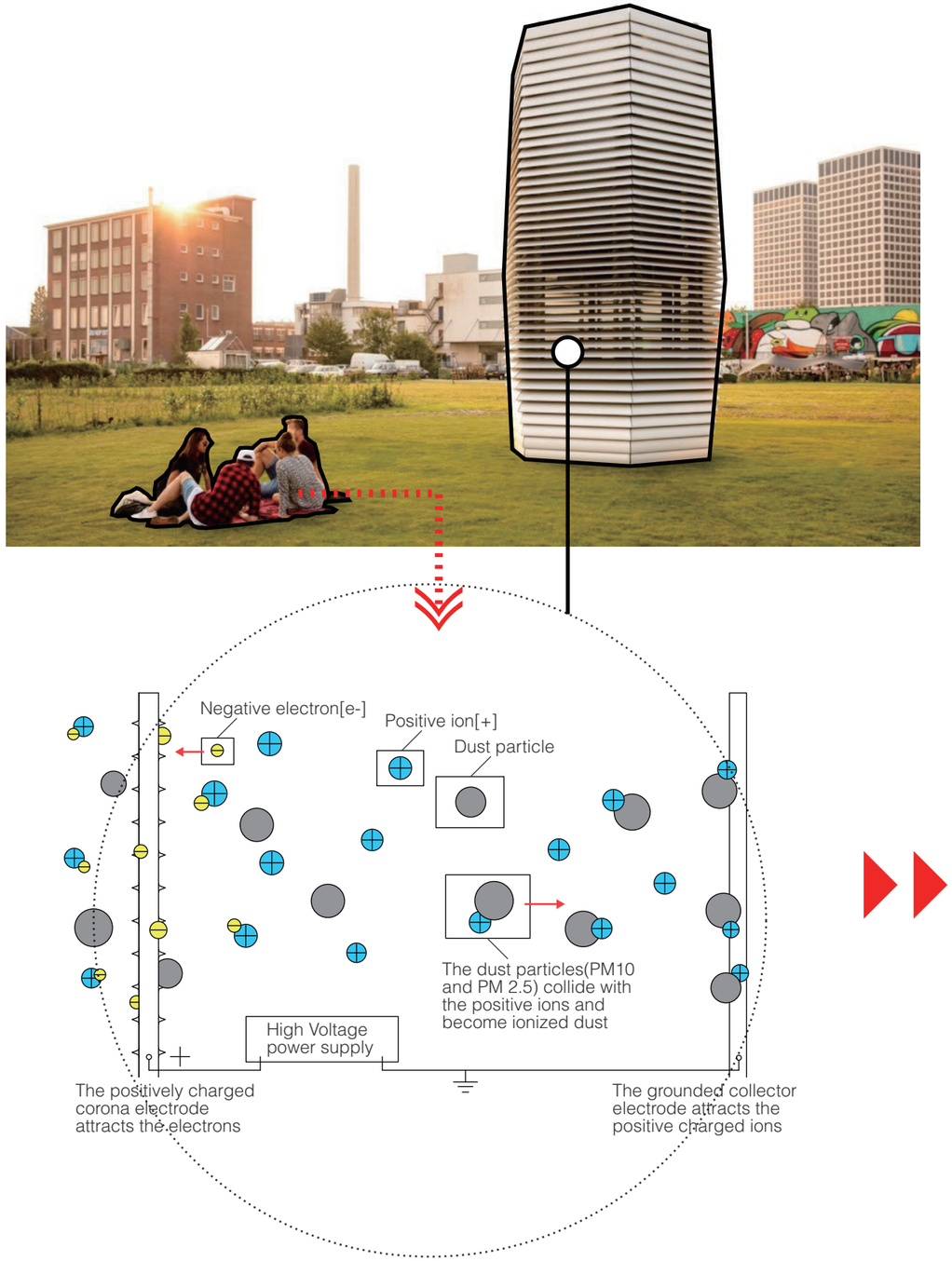
Using visualization to bring life to a concept and adding depth through spatialization gives the perspective needed to take architectural design into a completely new arena.

"Shell" + Plant = Plant of the Future

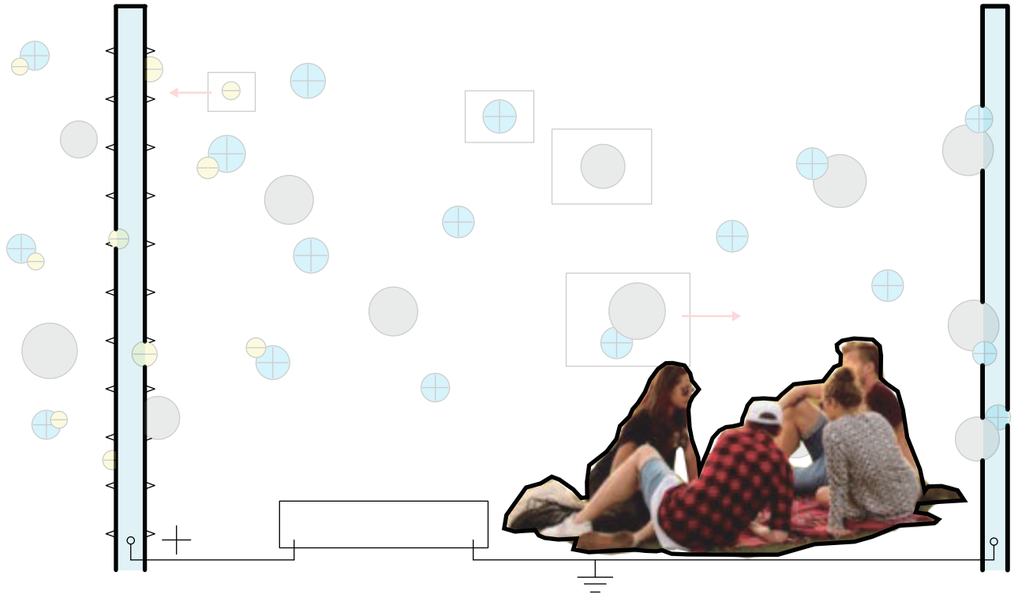


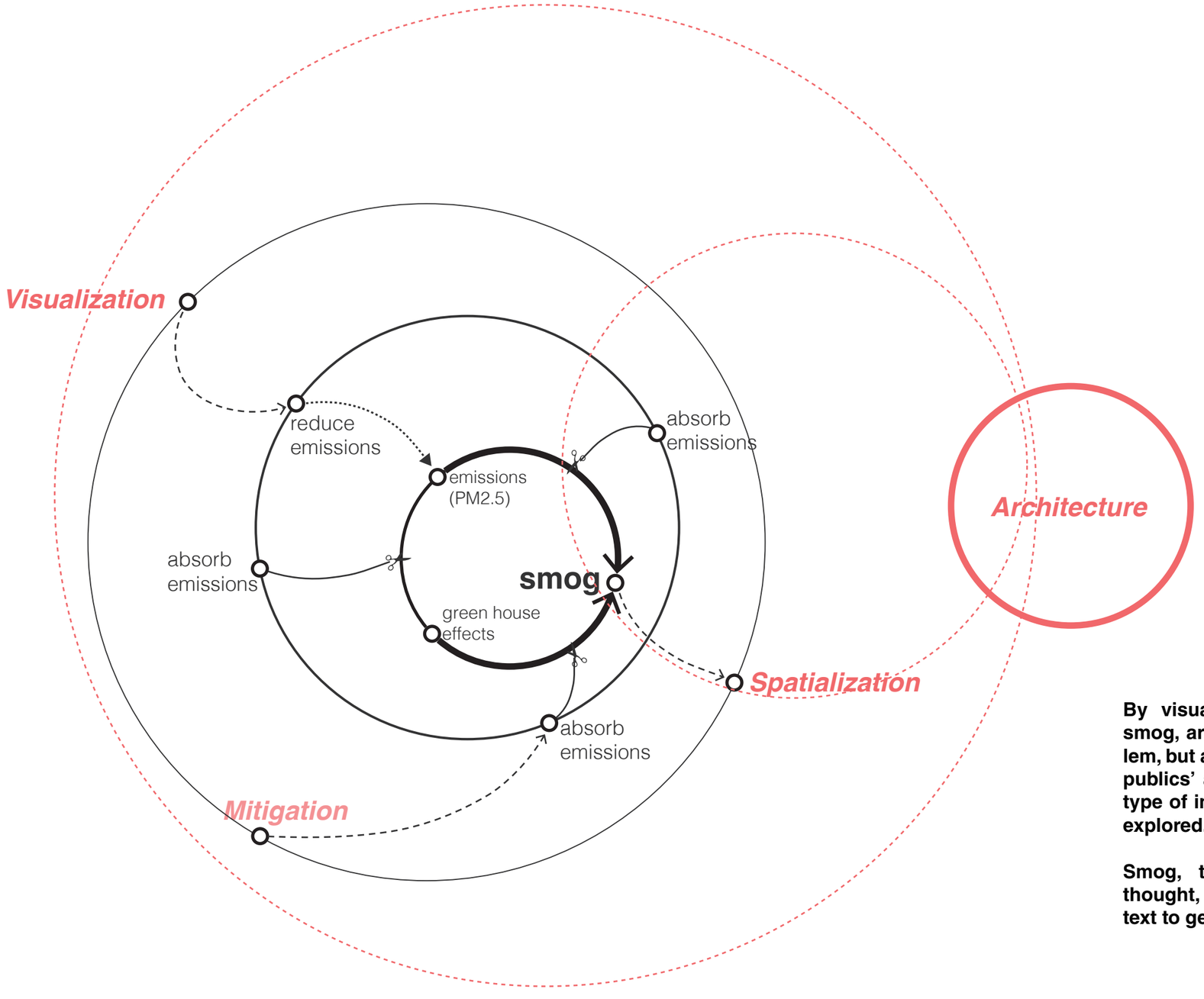
Community Programs:
cafe, convention facilities, and outdoor recreational area

Inside the facility, views of a surrounding industrial world provide a new vision of the city. The project suggests ways that nonindustrial and industrial uses might merge. It returns us to smoke and to the issues of industry, labor, and environmental degradation that smoke suggests.
One can only hope that this re-exploration of smoke will extend to other spheres, where smoke now appears as a peripheral and denigrated aspect of society and its practices.



In Daan Roosegaarde's project "Smog Free Tower", the team uses ion technology to produce smog-free air in public space, allowing people who are staying around the machine to breathe and experience clean air.
Then what if we enlarge the scale of this vacuum cleaner, and create space between its filter layers to make people not only staying around, but also entering into the machine and interact with it?



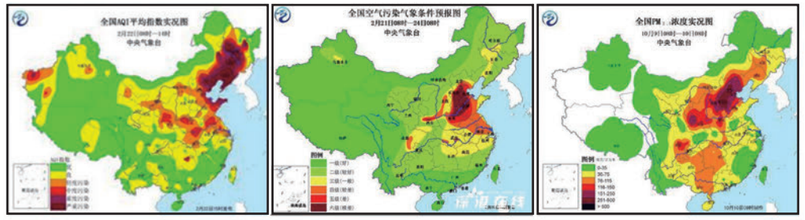


By visualizing and spatializing the issue of smog, architecture not only mitigates the problem, but also represents a process that can raise publics' awareness, as well as creating a new type of interactive space to be experienced and explored.

Smog, thus, is explored with architectural thought, and acts as the medium and new context to generate space.

3. LOCATING THE SMOG

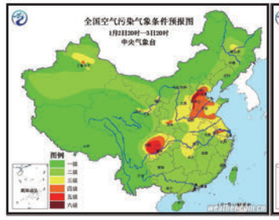
SMOG IN CHINA
SMOG-SCHOOL RELATIONS IN BEIJING
PROPOSAL: BETWEEN FILTERS: SPACE AND IMAGE PRODUCTIONS



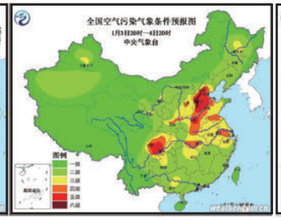
2014.02.20

2014.02.21-24

2014.10.09



2015.01.02



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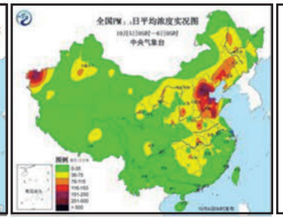
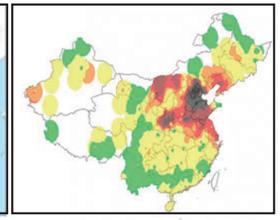
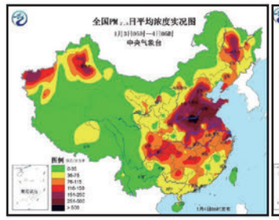


2015.10.05



2015.11.30



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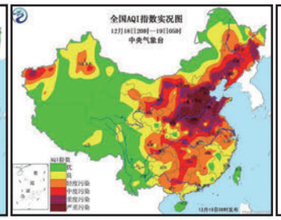
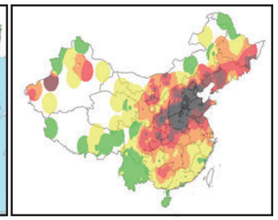


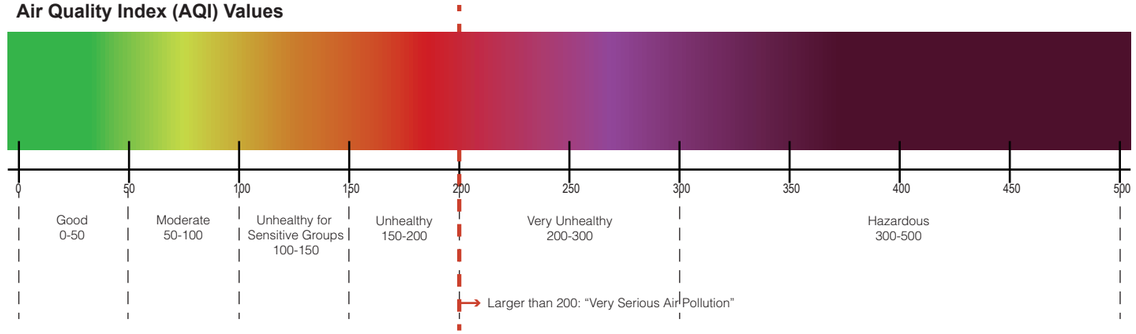
2016.12.18

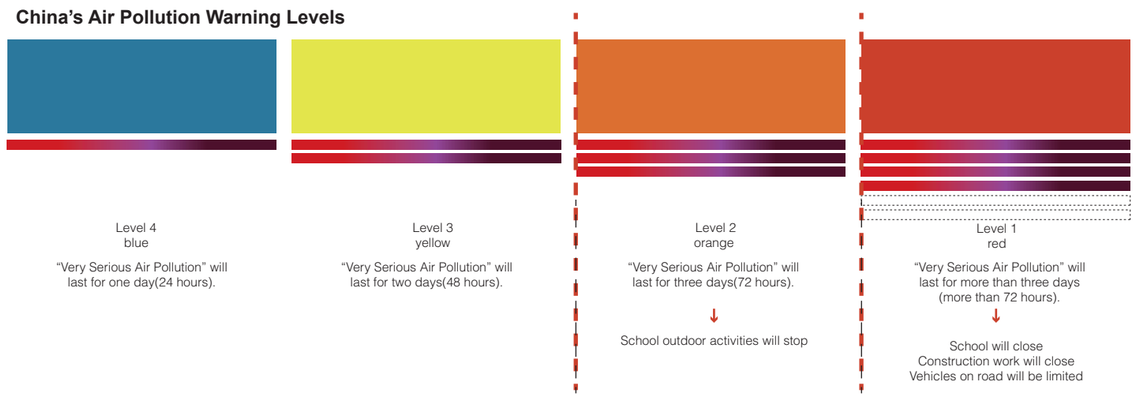


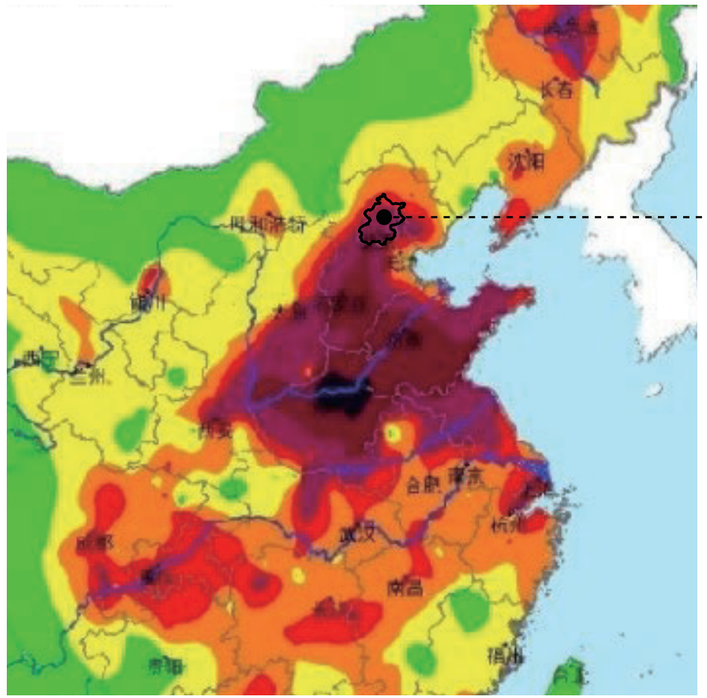
2016.12.19

Fig. 13 AQI Map of China

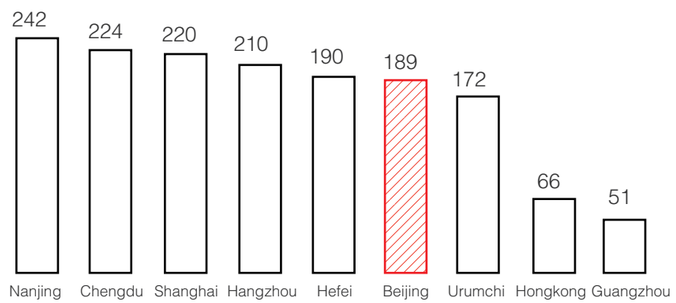
Data Source:
Ministry of Environmental Protection of People's Republic of China, 2014-2016



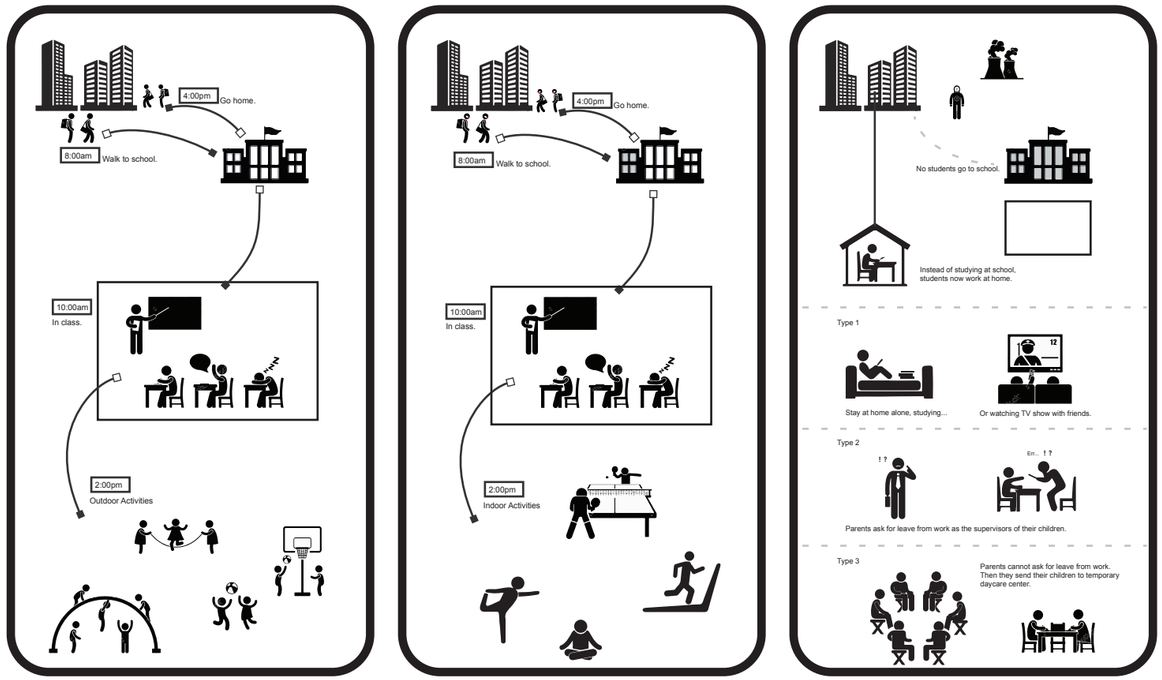


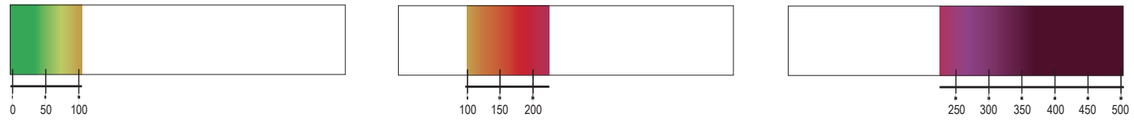


Beijing is among the most polluted areas in China.



Number of polluted days across cities, 2013



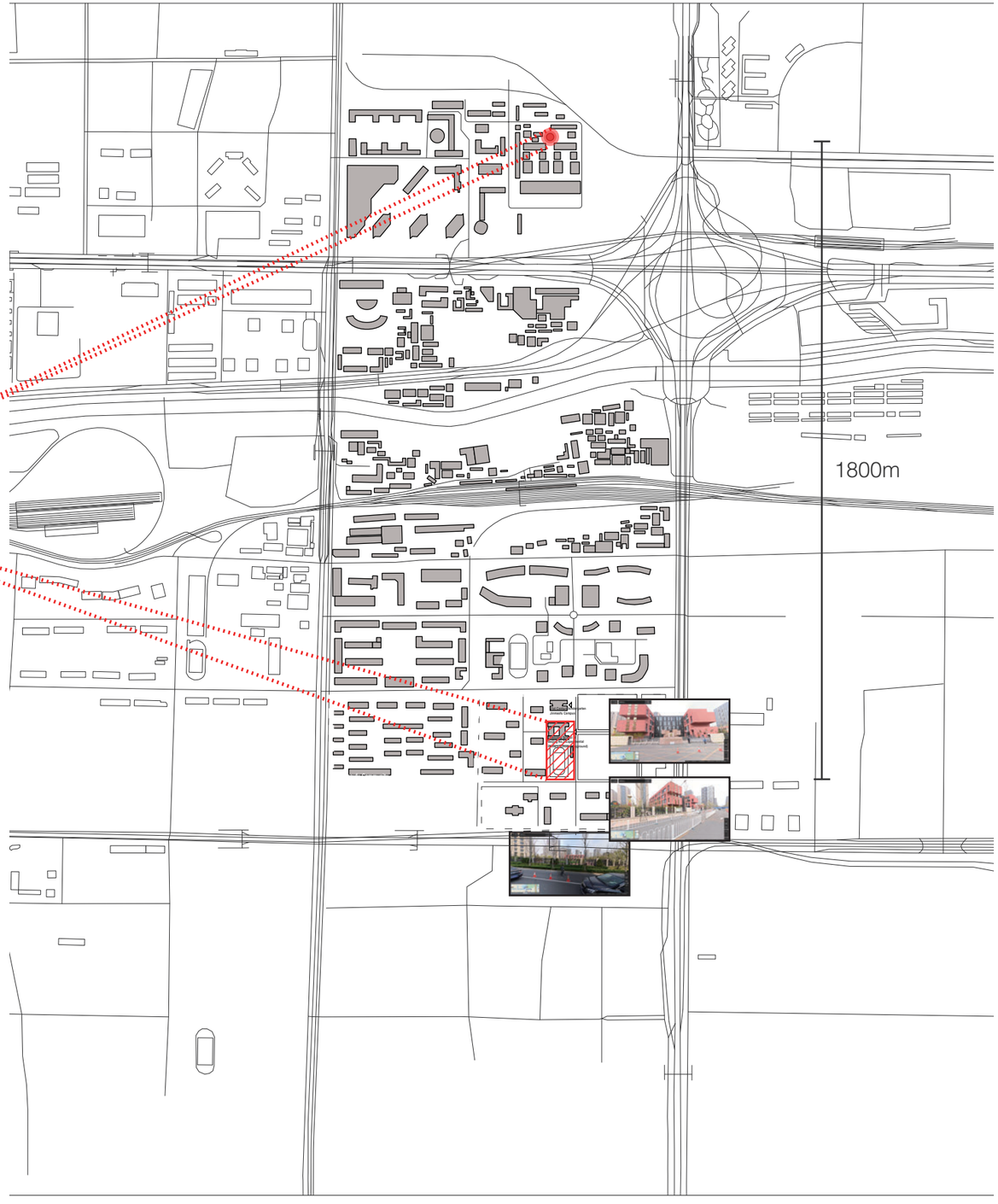


At December 16th 2016, Beijing Municipal Commission of Education started an instruction on closing schools due to the bad air pollution in Beijing. According to the weather forecast, from December 16th to 21th, the air pollution will reach warning level 1(red warning). Under this situation, all the primary schools, kindergartens, as well as the extracurricular educational institutions need to be closed and stop normal school activities for a few days.
This notification aims to protect children from the polluted air. However, it causes other issues and turns the situation into a dilemma.

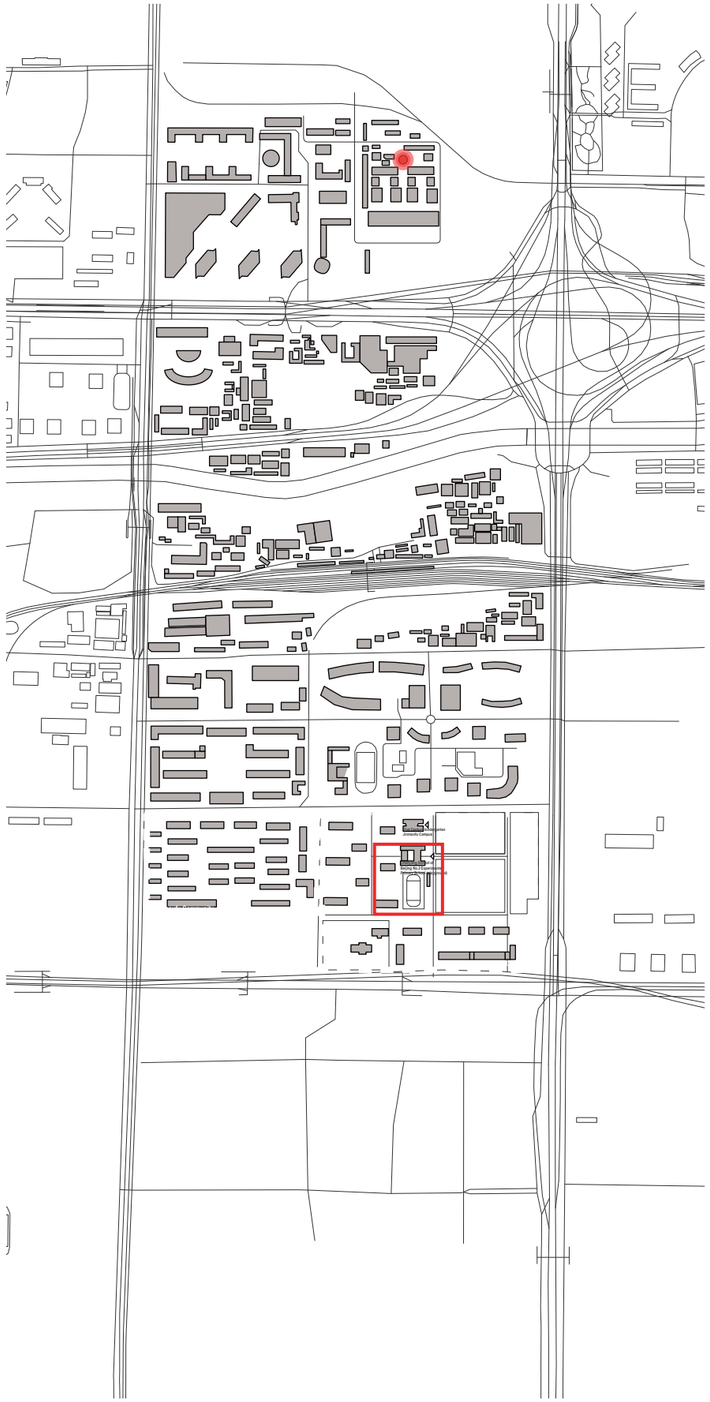
LOCATING THE SMOG

- Thermal Power Plant in Beijing
- Main Wind Direction in Beijing

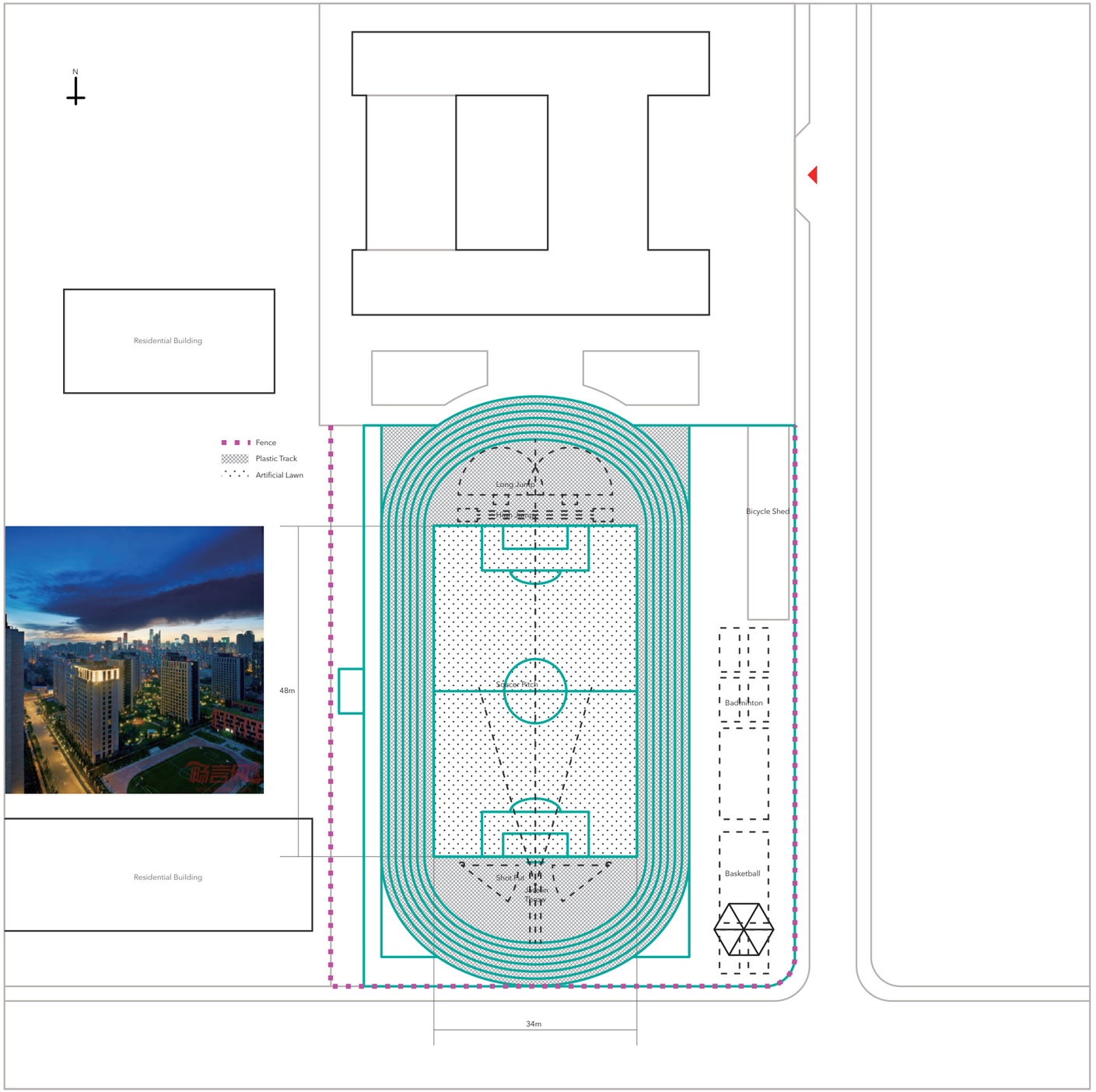
SMOG-SCHOOL RELATIONS IN BEIJING

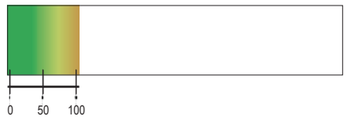


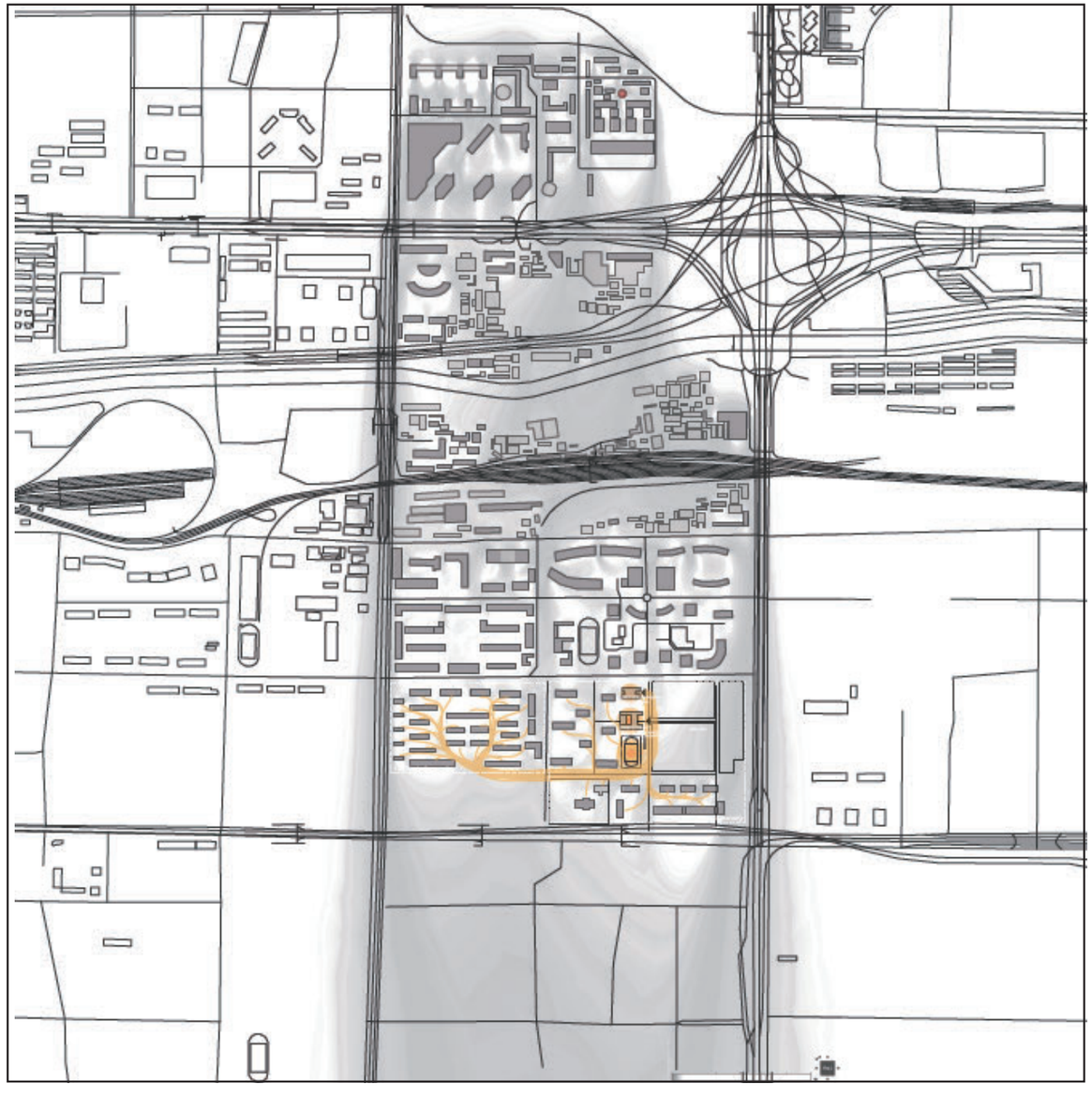
LOCATING THE SMOG



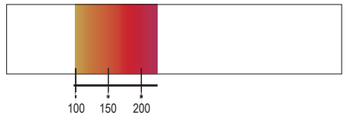
SMOG-SCHOOL RELATIONS IN BEIJING

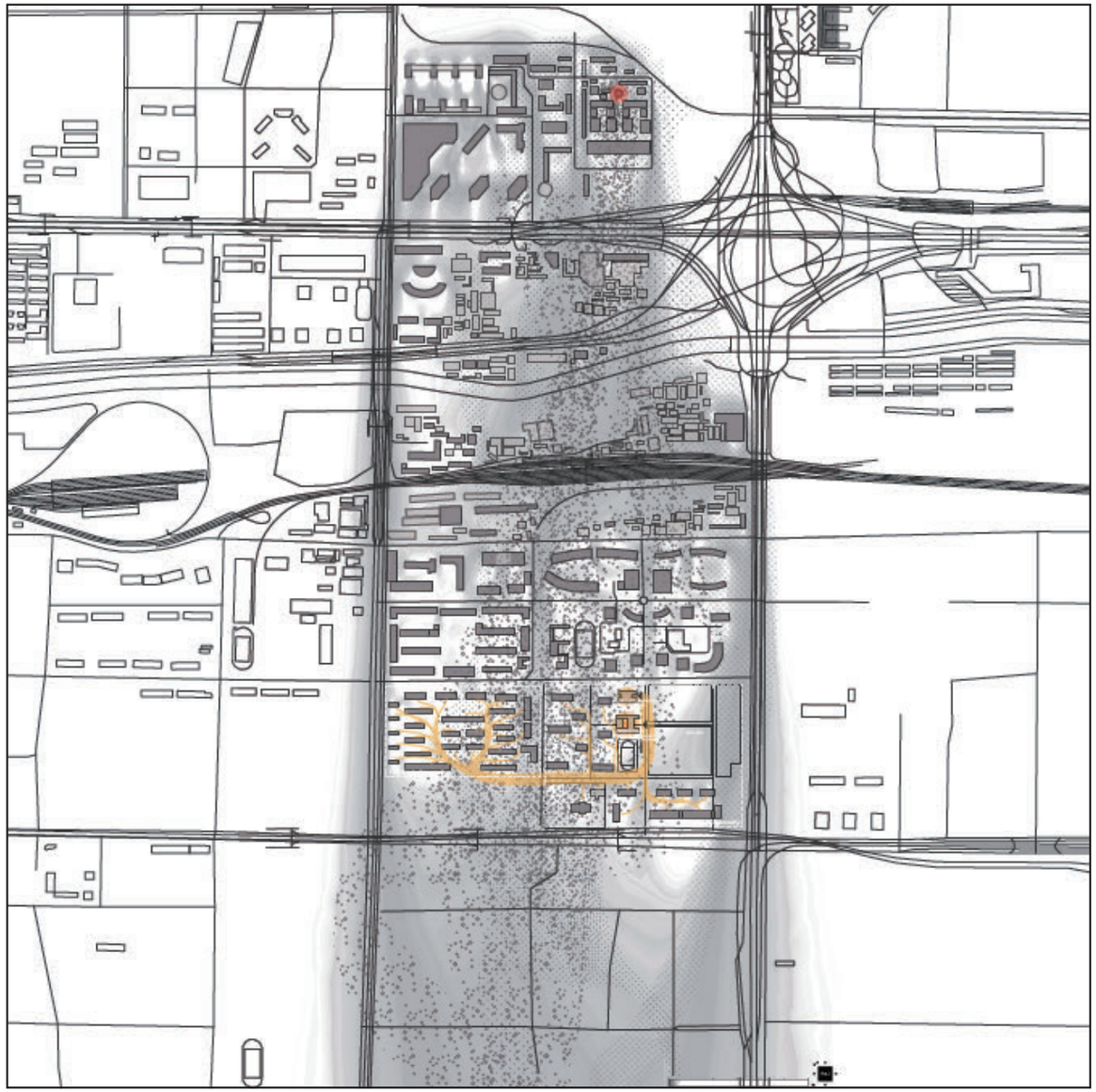




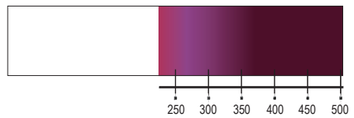


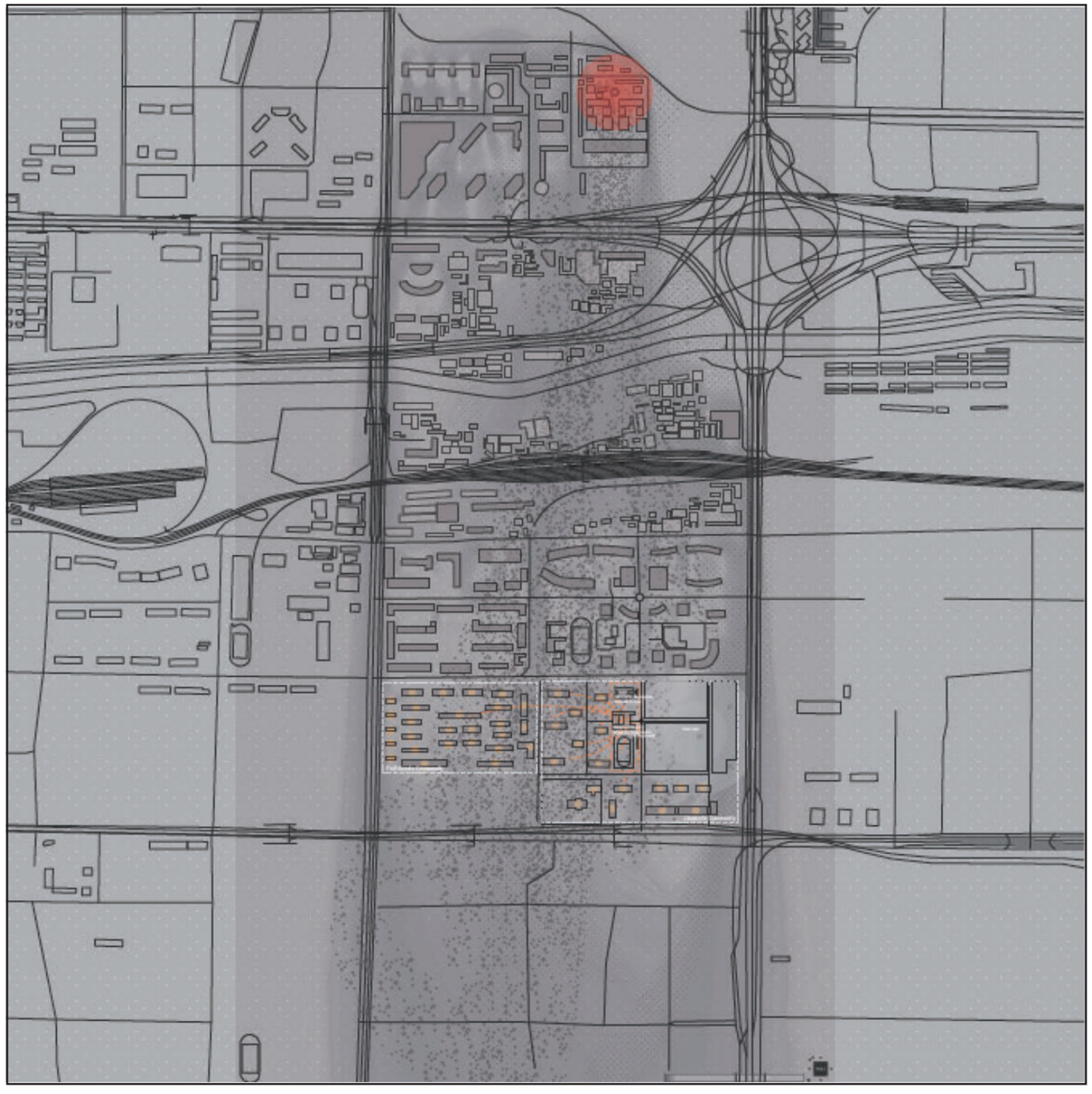
Scenario 1:
A clear day. Has more possibility to happen in summer.

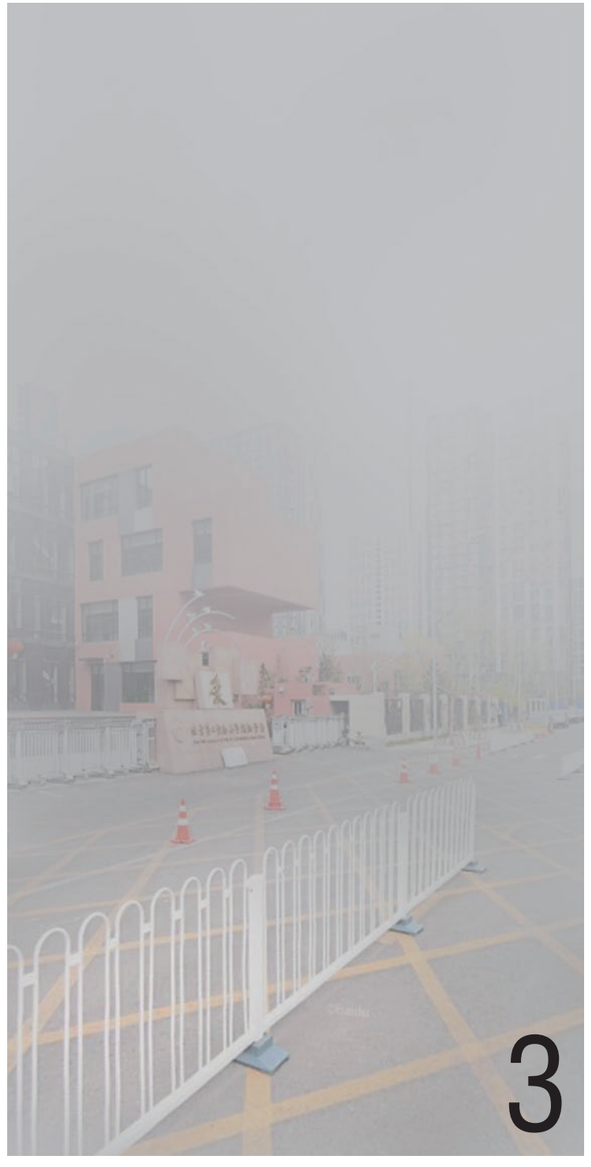




Scenario 2:
A moderate polluted day. Has more possibility to happen in winter due to the heating requirement.



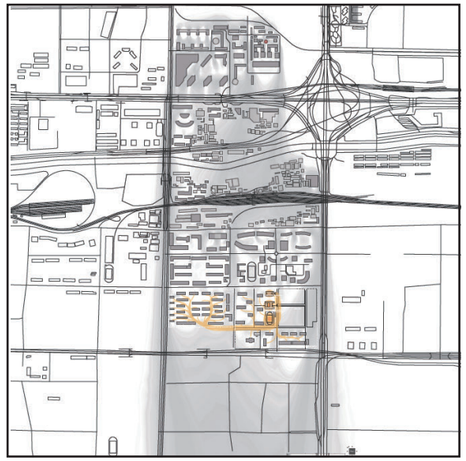




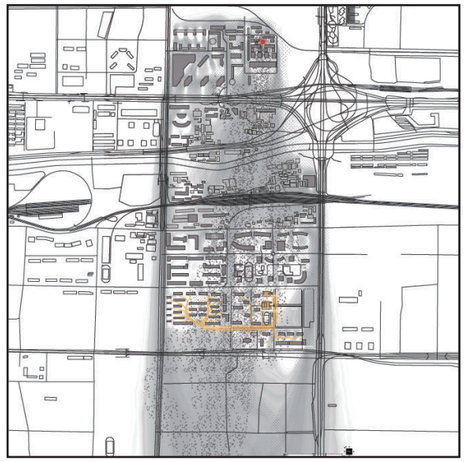
3

Scenario 3:
A badly polluted day with heavy smog. Has more possibility to happen in winter after the static stability weather.

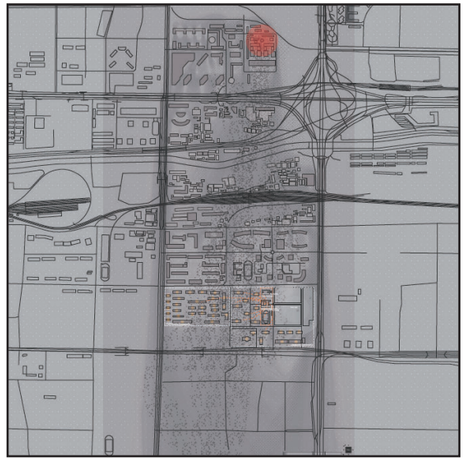
LOCATING THE SMOG

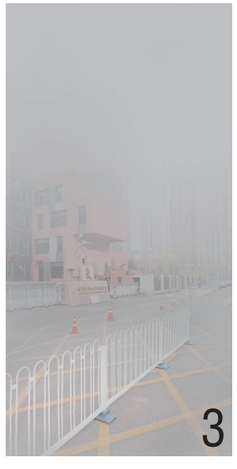


Scenario 1:
A clear day. Has more possibility to happen in summer.



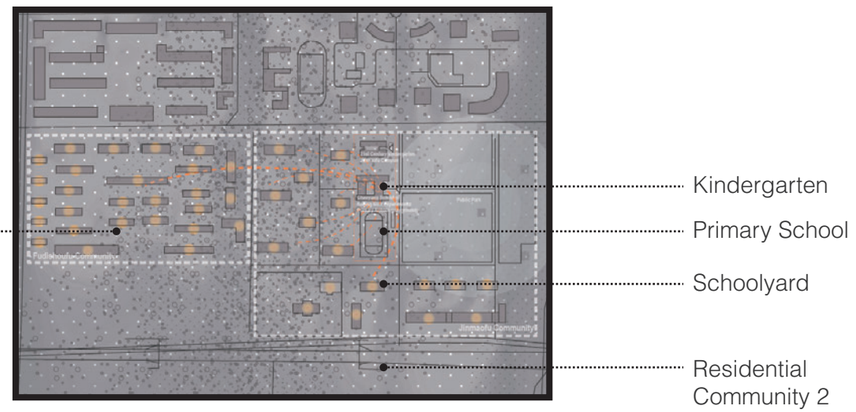
Scenario 2:
A moderate polluted day. Has more possibility to happen in winter due to the heating requirement.



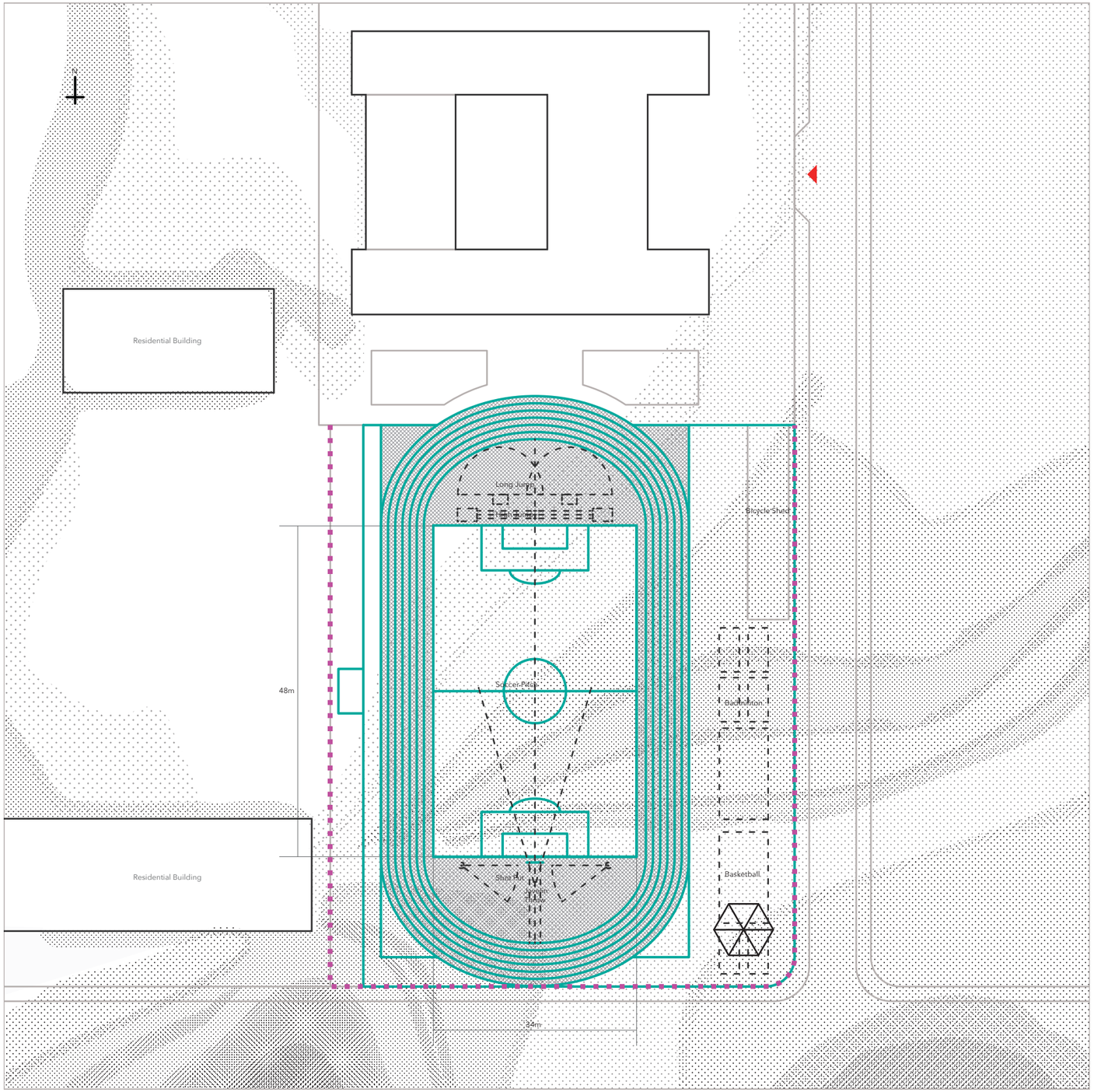


Scenario 3:
A badly polluted day with heavy smog. Has more possibility to happen in winter after the static stability weather.

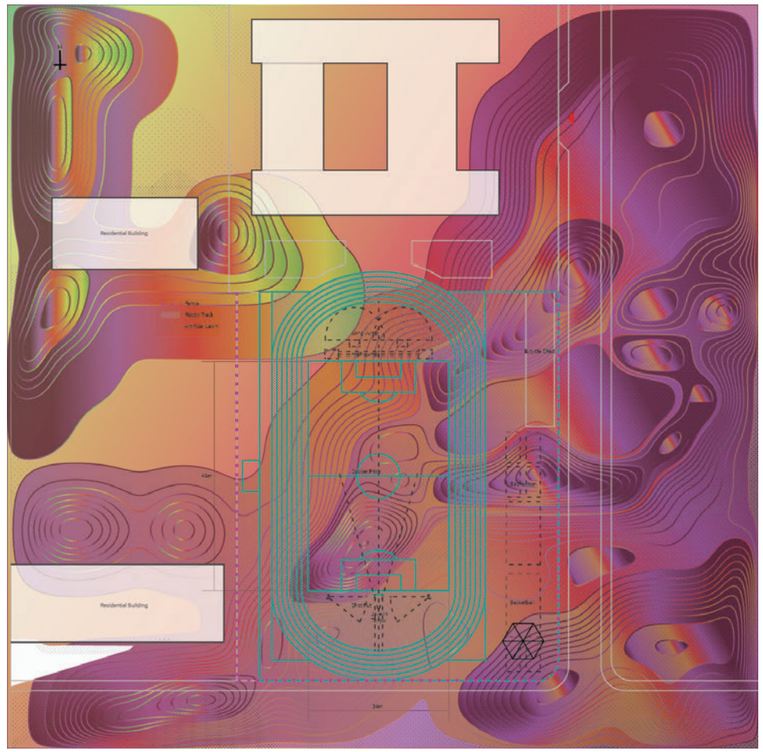
SMOG-SCHOOL RELATIONS IN BEIJING

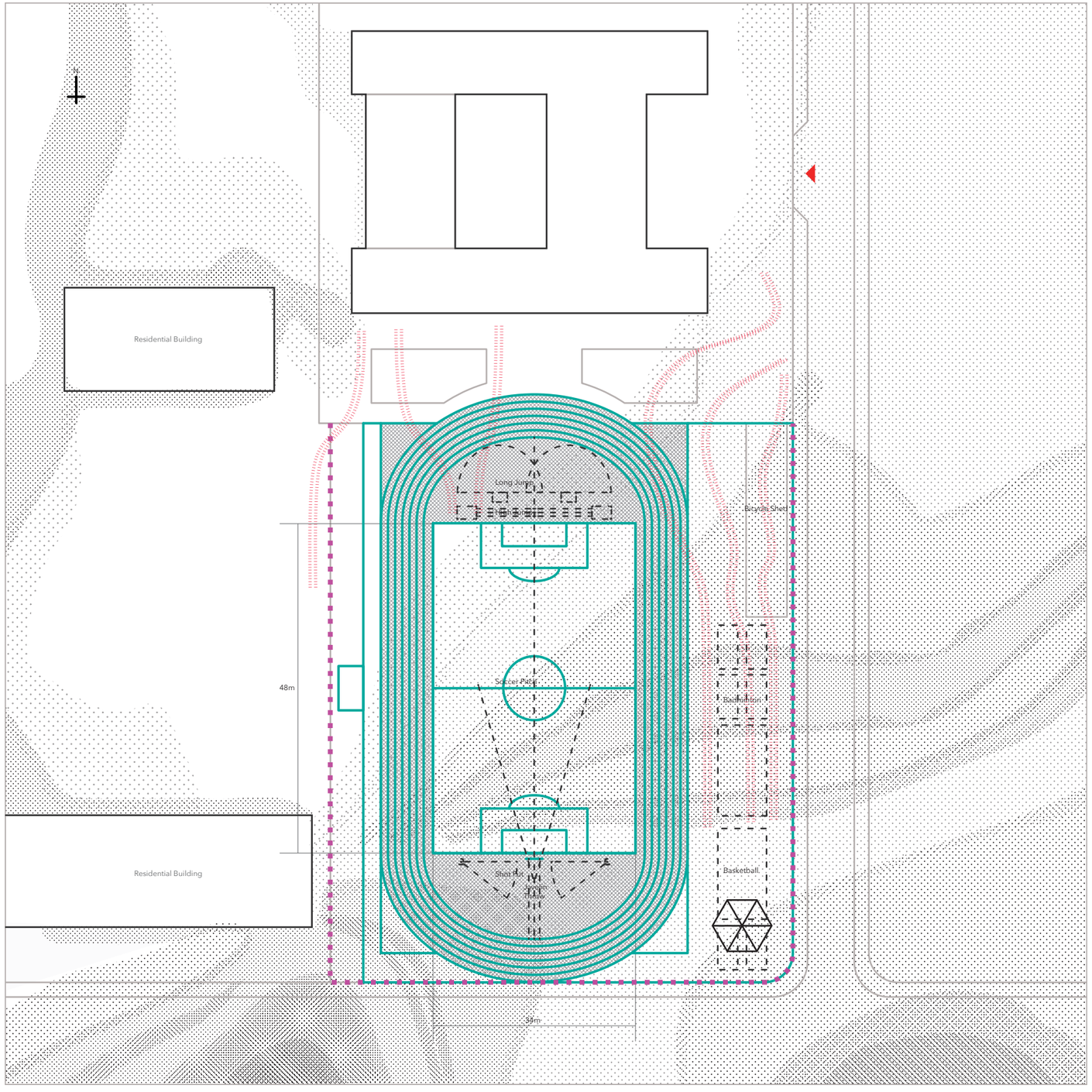


Jinmaofu Community

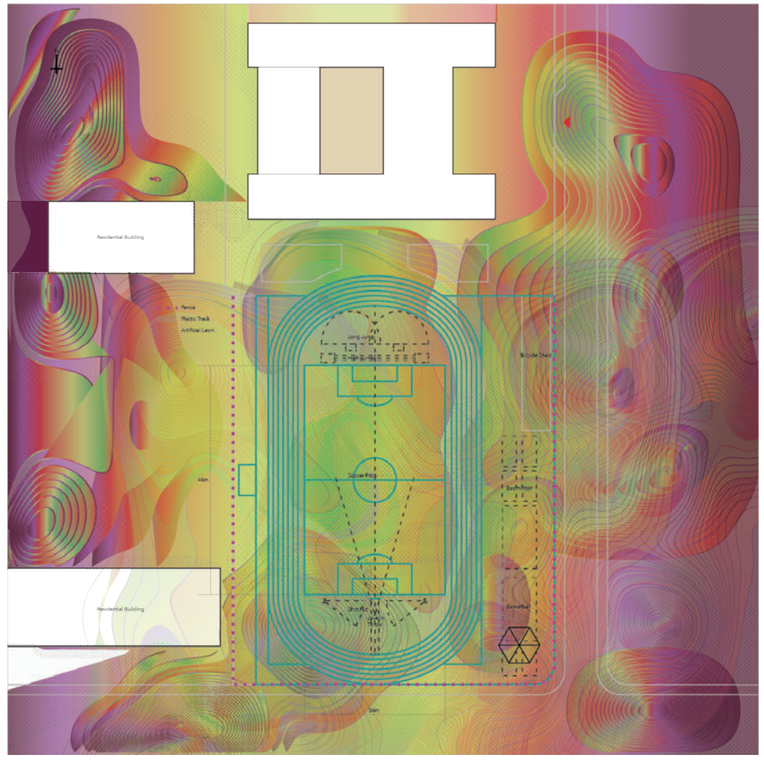


The schoolyard can be distribute into different zones in polluted seasons considering the wind effects because wind will bring in the pollutants from north part of the city.

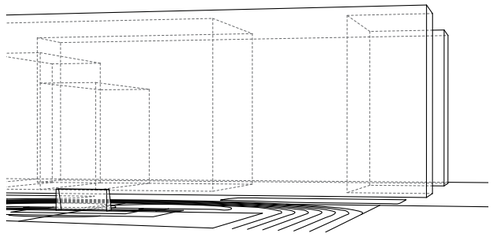


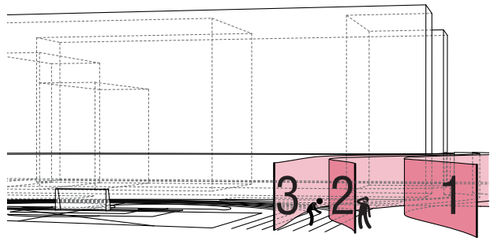


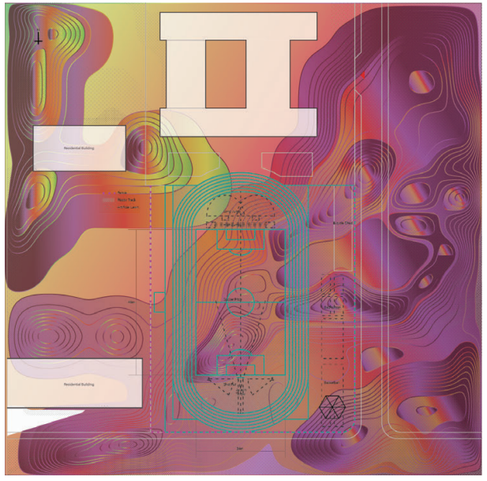
However, by the intervention of air filters, not only the polluted area is reduced, but also the distribution of different zones could be manipulated by the position and shape of the filter layers.

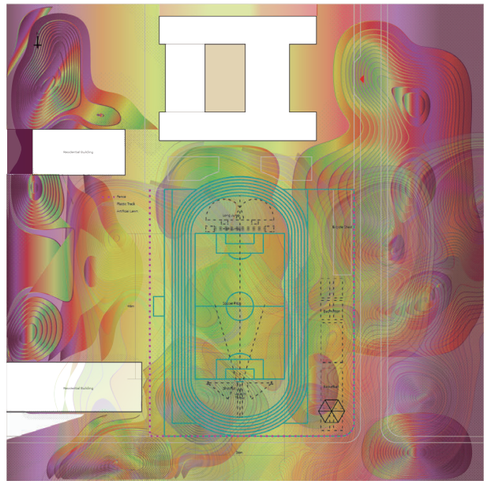


LOCATING THE SMOG

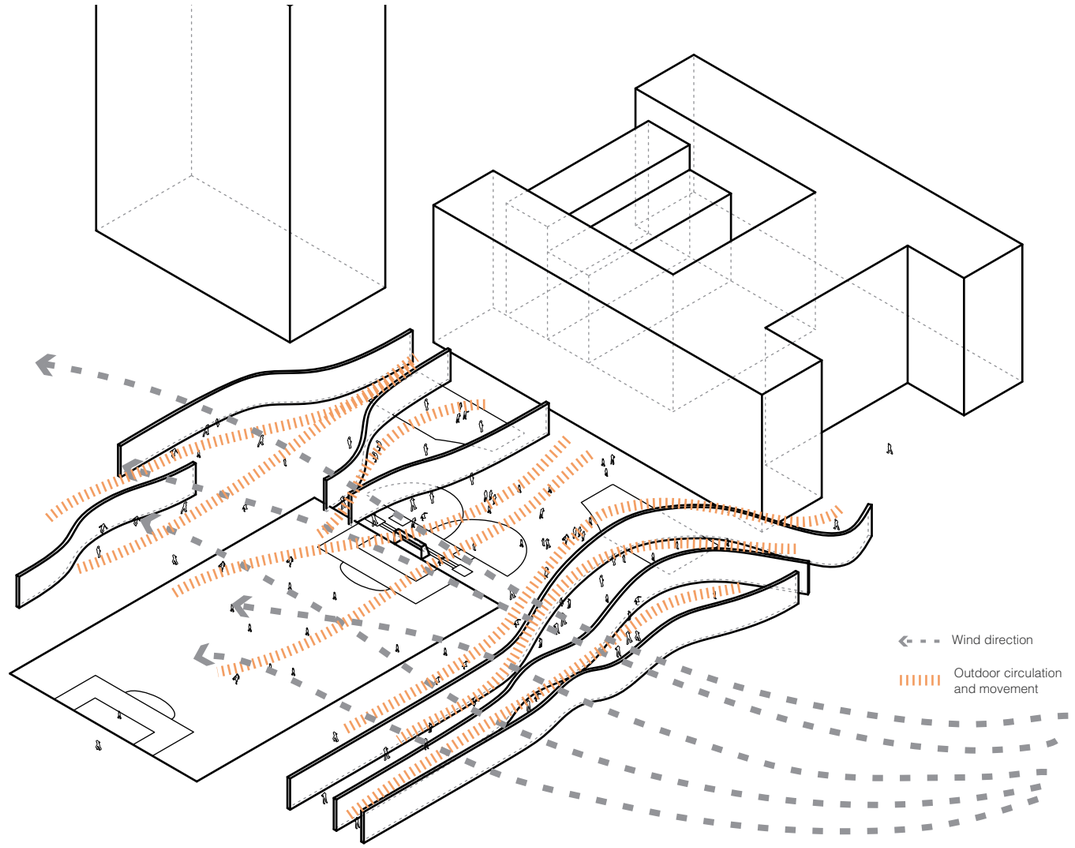


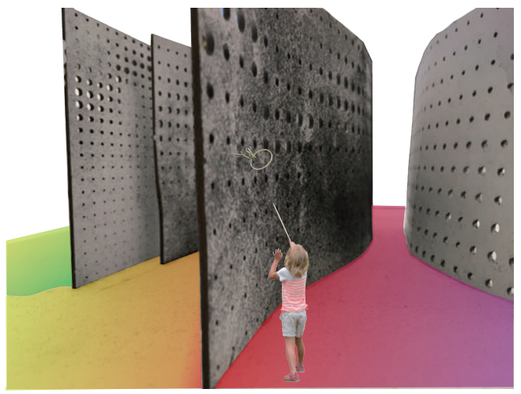






PROPOSAL: BETWEEN FILTERS: SPACE AND IMAGE PRODUCTIONS





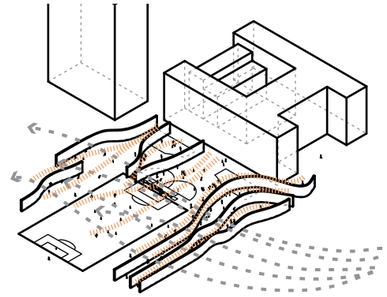
The use of a single air cleaner layer alone may not ensure adequate air quality, particularly where ventilation is insufficient. While air cleaning can help control the levels of airborne particles including those associated with allergens and gaseous pollutants, to provide a relatively better air condition.

ELECTRONIC AIR CLEANER

Then, the air passes through the electronic air cleaner. It has an ionization section and a collecting plate section, both of which use an external power source. The air goes through the ionization section, where particles obtain an electrical charge. All particles, even the smallest particles down to 0.3 micron are given an electric charge. The charged particles accumulate on a series of plates called a collector that is oppositely charged.

2.HEPA FILTER

Mechanical air filter. It's good at capturing dust, pollen, some mold spores, animal dander, and particles that contain dust mite and allergens.
HEPA filters are made from a fabric of tangled, warped fibers. These fibers are in a random pattern, with strands bending and curving in all directions to form a confusing, twisty maze that the air must go through. As the particles pass through the filter, they are caught in this maze in four ways: impaction, sieving, interception and diffusion.
But a HEPA filter doesn't capture everything: a small number of particles larger than 0.3 µm will still get through. Smaller particles will also still get through. In particular, many of the particles such as the PM2.5 particles in urban smog are too small to be MOSTLY captured by a HEPA filter.



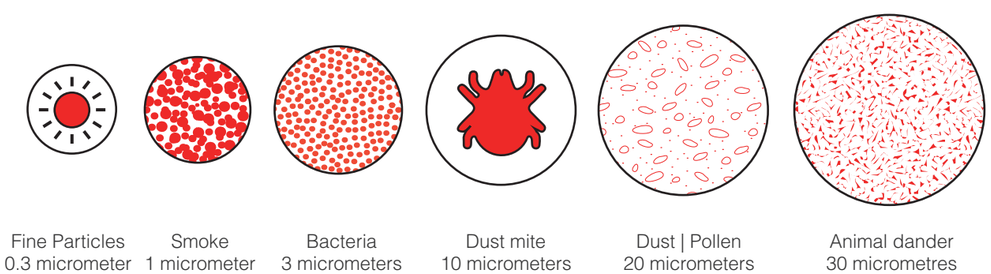
1.PREFILTER

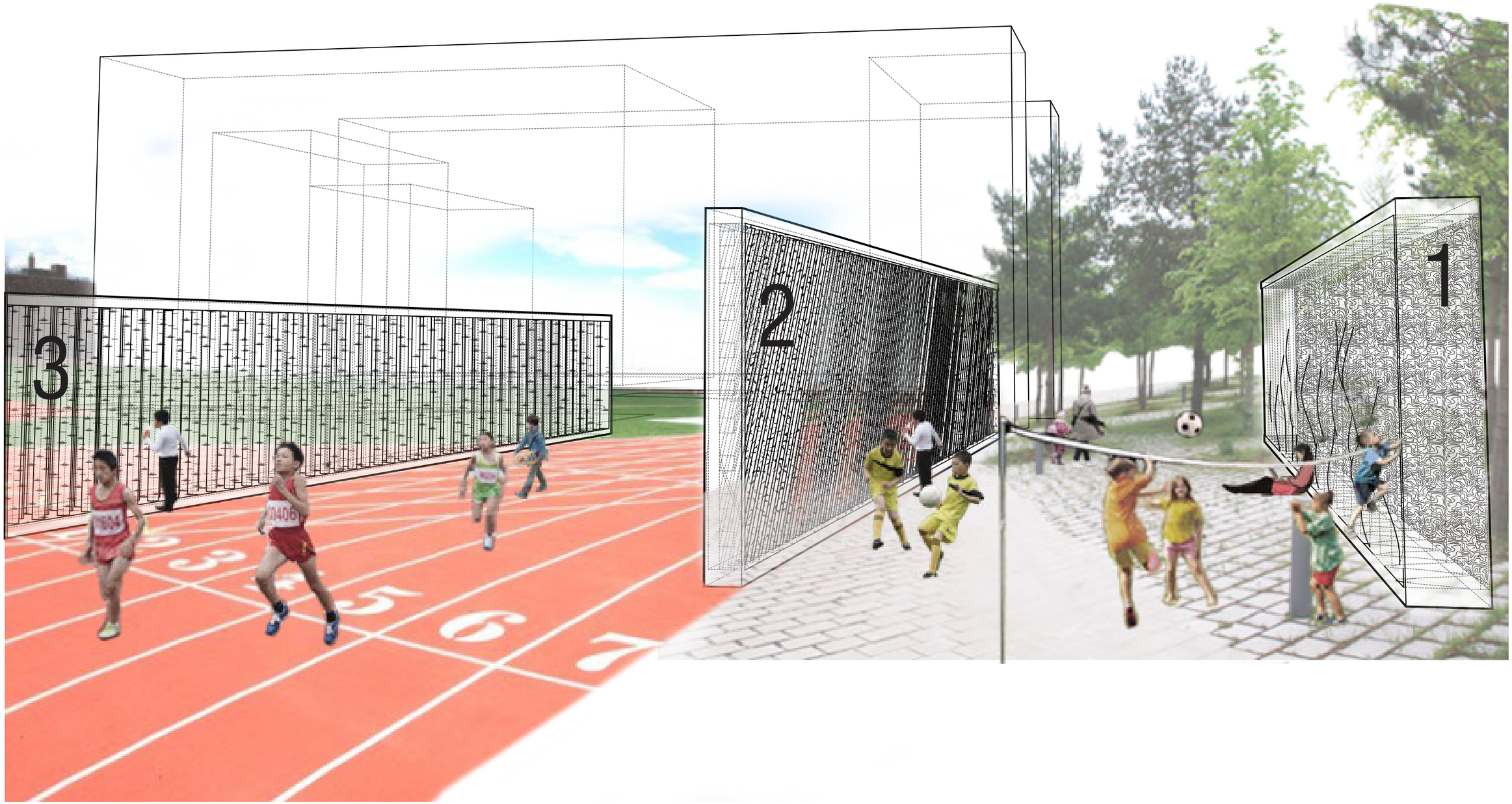
First, large particles (lint, hair, willow catkin) are caught by the prefilters. Usually it's made of Poly, Synthetic or Fiberglass.

3

2

1




3
2
1

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Design Document Series_05. *Corrupted Biotopes_ R&Sie...Architects.* (Seoul: DAMDI Architects Publications, 2004)

Similar to *Spoiled Climate*, this book also talks about the works by R&Sie. The idea in my proposal that people and smog could both occupy in a same space respectively is inspired by their project B_Mu Museum and Mosquito Bottleneck.

Gissen, David. *Subnatures: Architecture's Other Environments.* (Princeton Architectural Press: 2009)

This book argues the relationship between architecture and environment, especially the "negative" environment, which the author call it "subnature". But instead getting rid of subnature, David tried to think about it in a more positive way in the relationship with architecture. This book is the starting point for me to think the way we think about smog and possibility that use smog as a new context and generator for visualization and spatialization in architectural design.

Lally, Sean and Young, Jessica. *Softspace: From A Representation Of Form To A Simulation Of Space.* (Abingdon, Oxon, New York: Routledge, 2007)

This book talks about the invisible flow and energy, like wind direction, temperature, air quality, etc, the simulation and representation of the energy and the space forming from these data.

Ruby, Andreas and Durandin, Benoit eds. *Spoiled Climate: R&Sie...Architects.* (Basel, Boston: Birkhäuser Publishers for Architecture, c2004.)

This book explained and analyzed the projects did by the architecture studio R&Sie, as well as the design concept of this studio. The works by R&Sie may not be easily understood by the public; it's something niche or weird, but with different and deep thoughts from other subjects without architecture. Thus the results and the final works are pushing people to think architecture in different ways.

Rojas Del Alamo, Marta. Design For Fun: Playground. (Barcelona: Links International; 2004)

This book shows the studies about children's activities and the space they could enjoy. The author uses various playground examples to illustrate the ideas behind the design of children's playground.

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Http://earthobservatory.nasa.gov/IOTD/view.php?id=89228

"The haze stranded passengers at airports and slowed down city life in northern China.
An orange alert signals heavy pollution—a PM2.5 (particulate matter) density of more than 150 micrograms per cubic meter of air—for three consecutive days. Such high concentration of fine particles in the air can cause lung and heart problems for vulnerable individuals, including asthmatics, children, and the elderly.
On December 5 2016, People's Daily reported smog blanketing more than 60 Chinese cities.
Low winter temperatures exacerbate smog since they cause temperature inversions. Warm air settles atop a layer of cooler, denser, smog-ridden air, trapping it like a lid."

https://www.dezeen.com/2016/09/30/smog-free-tower-daan-roosegaarde-beijing-china/